THE RELATIONSHIP OF LEVELING-SHARPENING COGNITIVE CONTROLS AND MANIFEST ANXIETY TO THE ACCURACY OF VISUAL SIZE JUDGMENTS

BY

KENNETH S. NICKERSON

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COGNITIVE
ACCURACY

by

Kenneth S. Hickerson

Department of Psychology
Duke University

Date: April 1959

Approved:

Louis D. Cohen, Supervisor

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the Department of Psychology in the Graduate School of Arts and Sciences of Duke University

1959

Duke University Library

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K. S. N.

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THE RELATIONSHIP OF LEVELING-SHARPENING COGNITIVE CONTROLS AND MANIFEST ANXIETY TO THE ACCURACY OF VISUAL SIZE JUDGMENTS

Chapter I

INTRODUCTION AND HYPOTHESES

The Problem

Cognitive controls. Important for the understanding of perceptual, motivational, and other personality processes is a set of variables which have been variously termed cognitive controls (55, 70, 105), cognitive system-principles (43, 102), cognitive attitudes (39, 55, 100), cognitive styles (28, 59), perceptual attitudes (53, 56, 61), Anschauungen (53), coping modes (60), and regulatory structures or delay mechanisms (55). Cognitive controls are stable patterns or styles of response characteristic of an individual in a wide variety of situations but differing considerably from one individual to another. They have been described as preferred ways of solving tasks requiring adaptation, and they serve as regulating structures which "modulate, facil-

itate, inhibit, counteract or otherwise qualify the discharge of need-tension in behavior" (55). Cognitive controls have been defined as "sets or dispositions of the organism--a sort of prevailing structure--which determine the pattern or style of an individual's response to situations" (70). Whereas needs, drives, and other motivational forces serve to energize or "push" behavior, these control aspects of personality act to channelize, direct, and regulate behavior.

These control processes have been emphasized and have had extensive experimental investigation by G. S. Klein (15, 16, 28, 37, 39, 43, 44, 53-57, 59, 61, 100, 102, 103, 105), R. S. Lazarus (69, 70, 71), H. A. Witkin (125, 126), and their respective associates and students, particularly in the field of perception. A number of control dimensions have been isolated and found to account for a significant amount of the individual differences in perceptual and motivational studies. Among these dimensions are "tolerance vs. resistance to the unstable" and "physiognomic vs. literal" (53, 54, 60, 61), "categorizing behavior" (28), "focusing" (100), "interference proneness" (55, 70), "verbalness" (70), and the one used in the present experiment, "leveling vs. sharpening" (37, 39, 43, 53, 54, 56, 57, 60, 90, 102, 103).

Leveling and Sharpening. Leveling and Sharpening cognitive controls were operationally defined by Klein and his co-workers

in terms of a dimension of perceptual accuracy. The defining task (The Schematizing Test) requires the subject to judge the size of squares presented visually, the sizes increasing gradually as the task continues. In their early studies the Klein group analyzed the subjects' responses to this task for stable patterns, and identified at least two major modes or styles of response: progressive underestimation leading to inaccurate judgment, and appropriate shifting resulting in consistently high accuracy of judgment. The individuals at the lower end of the accuracy distribution were called Levelers, and those at the upper end were called Sharpeners (53).

Subsequent experimentation led to a more precise characterization of these cognitive controls. Klein found that Levelers had greater difficulty in separating figure from ground in three situations, including the Gottschaldt figures test (53). Holzman (39), working with Klein (43) demonstrated that assimilation effects in visual, auditory, and kinesthetic time-error were greater for Levelers than for Sharpeners. Using a Gestalt neurophysiological model to explain their findings, Holzman and Klein suggested that differences between Levelers and Sharpeners may be due to characteristic differences in the brain field: Levelers have weaker boundaries between traces in the brain field, and there is a tendency for greater exchange of energy between traces.

Noting Koffka's (62) explanation of retroactive inhibition as being due to the interference with each other of similar traces, Holzman predicted that if trace boundaries are weaker in Levelers, this group should show greater retroactive inhibition than Sharpeners (39). Sharpeners should more easily maintain the discrete differences between stimuli, resulting in more accurate discrimination and less interference.

The purpose of the present experiment was to demonstrate the generality of Leveling and Sharpening in a new situation, and to assess the influence of these controls on the expression of some type of motivational or drive behavior. Since a great deal of work had been done recently with manifest anxiety, interpreted as drive (108, 116), this variable was selected for study in conjunction with the Leveling-Sharpening cognitive controls.

Manifest anxiety. Using scores on a self-administered questionnaire of chronic anxiety items as a measure of level of internal drive (23, 108, 114, 115, 116), Spence, Farber, Taylor and their associates at Iowa and elsewhere have conducted an extensive series of experiments aimed at clarifying the concept of drive within the framework of Hullian learning theory. Over approximately eight years, considerable experimental support has been found for drive theory hypotheses and the validity of the Manifest Anxiety Scale as a measure of drive (116). Numerous contradictory results, alternative interpretations, and qualifi-

cations have also appeared (see for example 9, 13, 47, 77, 80). Comprehensive summaries of this work are available (108, 116).

In general, higher scores on the Taylor scale tend to be associated with more rapid conditioning and greater resistance to extinction in simple noncompetitional classical reflex conditioning situations (110, 114, 116). Results in differential conditioning and nonavoidance situations have been inconsistent (3a, 36, 109, 111). Studies of the relation of manifest anxiety scores to various types of maze and verbal learning have suggested that the specification of difficulty level, or the number and strength of the competing response tendencies, is necessary in order to make valid predictions. High anxiety subjects tend to perform better on easy tasks, whereas they are relatively inferior to low anxiety subjects on more difficult tasks (25, 73, 88, 95, 113, 118).

In a variety of studies, scores on the self-administered MAS correlated in the vicinity of .60 with clinical ratings of manifest anxiety, though much smaller relationships have also been reported (7, 29, 68, 104). The scale has been found to contain at least five identifiable factors (91). Some investigators have suggested that the MAS reflects a potentiality for anxiety <u>arousal</u> under stressful conditions rather than a chronic anxiety or drive state, but this issue is still far from settled (116, 117). Although the results of some studies have been attributed to dif-

ferences in intelligence between high and low anxiety groups, it has been established that MAS scores are essentially unrelated to measures of intelligence within the usual ranges of scores employed in the majority of studies (112).

A few studies have appeared which have had more direct relevance to the focus of the present experiment which involves the relation of manifest anxiety to retroactive inhibition and the related variables of interference, discrimination and generalization, transfer, similarity, and difficulty level. Anxious subjects have been found to show greater stimulus generalization (124), but in some cases only if stress is present (96, 97) or inferred (48, 85); in one study the anxious subjects showed less generalization (21), and in two recent studies no differences were found between high and low anxiety groups (6, 22). Previous studies at Duke found anxious subjects to have poorer discrimination as measured by the flicker fusion method (30, 65, 66, 120) and slower reaction time, particularly on more difficult tasks (11, 121).

Studies relating manifest anxiety to transfer and interference have been more consistent. Negative transfer has been found to be greater for high anxiety subjects in three studies (14, 31, 67), and one of these demonstrated greater positive transfer for the anxious subjects also, although this study found that a female

group performed in the opposite way to the males (67). Highly anxious subjects seem to experience greater difficulty in shifting response patterns or sets (76, 84), but this finding is not consistent (12).

The present study used the Manifest Anxiety Scale, regarding manifest anxiety to be a drive state with potentially disruptive properties. It was hypothesized that high anxiety subjects would show greater susceptibility to the interference effects in a retroactive inhibition situation, and that they would discriminate more poorly, particularly where difficulty level was high.

Manifest Anxiety and Cognitive Controls: a Joint Function. It has been observed by Taylor (114) that almost all major systems for studying behavior have found it necessary to use two principle classes of variables: learning or cognitive, and motivation. Farber (24) appears to be making the same distinction when he says that the factors influencing performance in learning can be divided into the associative and nonassociative. Although directional or associative properties are commonly attributed to drives (e. g., a hunger drive "toward" food), a number of prominent theorists have argued that the drive aspects of behavior be conceptually divested of all directional, associative, or habit properties (1, 4, 8). Duffy (18, 19, 20) has even proposed that

all behavior can be analyzed into its basic components of direction and energy level, and this has been echoed by Bindra (3) and Malmo (75).

In the present study, the cognitive control is representative of the directional and directive aspects of behavior, whereas the anxiety variable may be considered primarily for its drive or arousal properties. To quote Lazarus: "Whereas motivational concepts most typically refer to an energizing force in behavior, controls refer to the structural aspects of personality which serve to channelize, direct, or otherwise govern motivational and affective expression" (70, pp. 8-9). A similar view is presented by Holzman and Klein (45). A close examination of the measures of control and drive used in the present investigation will show that neither variable is a "pure" measure, and that neither is free of some of the properties (directive or energizing) of the other.

The need for a model of the person's total functioning has been emphasized by many theorists, including Klein (52, 53), Krech (58, 64), Bruner (5), and Postman (93). The importance of including the ego structure and principles of control has also been highlighted (55, 60, 69, 70). For example, Witkin says:

> . . . in all psychological functioning, we are concerned with an active, integrated, purposeful agent--the person--equipped with characteristic ways of coping in all situations to which he must adjust, and operating with relation to a field of a particular structure. What, and how, he perceives depends on his distinctive coping mechanisms--together with his current motivations--and also with the nature of the real world with which he must deal at the moment (126, p. 499. Italics added).

Klein, in particular, has criticized the studies of the effects of needs on perception for their typical omission of the ground structure or control mechanisms of the individuals in whom the need is operative. "Behavior, then, expresses both the pressures of the needs and forces that counteract, qualify, or facilitate their gratification in keeping with the coping strategy that is invoked to meet the requirements and claims of reality" (55, p. 227). Both Klein (55) and Lazarus (70) have supported this point of view in experiments which have been able to find no main effect of needs, but have demonstrated significant interactions with coping modes and other personality variables.

Many of these same sorts of criticisms can be leveled against the majority of studies which have sought to uncover main effects of drive or anxiety, while neglecting implicit sets, habit patterns, coping mechanisms, and other more or less stable "control" properties of the organism (2). The drive theory advanced by the Iowa group states that "all habit tendencies elicited in a given situation are multiplied by the value of the total effective

drive then operating" (24, p. 322. Italics added). The resulting experimental studies have been careful to specify the "strength and number" of certain response tendencies in situations under investigation, but the effects of individual differences in response sets and habits which subjects bring with them into the situation have so far been minimized by the Iowa group. To quote Spence:

> In particular, we were sensitive to the possibility that the differences in anxiety were also accompanied by differences in response tendencies, e. g., degree of susceptibility to distraction, that might interfere with performance of the learning task. . . . As a matter of fact, we deliberately chose or attempted to arrange conditions in which such interfering aspects would be minimal . . . (107, p. 224).

By what means and to what extent this has been accomplished has not been explained in detail.

Up to the time of the present study no attempts had been made to include any stable response tendencies, such as cognitive controls or habitual coping modes, in the design of the anxiety experiments. Taking more seriously the recommendation of Klein, Witkin, Lazarus, and others that studies of drive should include stable control factors, the present experimental design provided for the investigation of both Leveling-Sharpening cognitive controls and manifest anxiety as they operated together in the individual and combined to affect performance.

A dimension of perceptual accuracy--accuracy of ranking in a temporal size judgment situation--is the basis for distinguishing Levelers from Sharpeners. Considerable evidence has been collected which suggests that perceptual accuracy is impaired by anxiety. Accordingly accuracy of size judgment should be influenced by both cognitive control and anxiety variables. Theory and empirical evidence has also led to predictions that both Leveling and manifest anxiety are related to heightened susceptibility to interference.

Previous studies by the present investigator (Appendix I) have demonstrated the essential independence of the cognitive control and manifest anxiety measures, but there is no clearly formulated theory to assist in the prediction of possible interrelationships of the control and anxiety variables in visual size judgment. Since both Leveling and manifest anxiety are associated with lowered perceptual accuracy, the effects of these two independent variables should at least summate. The possibility could also be raised that Levelers, because of their weaker trace boundaries, might show proportionally greater disruption due to easier diffusion or flooding of anxiety. Summation and possible interaction effects could be predicted also with regard to susceptibility to interference in size judgment. Finally, increased level of difficulty might be expected to accentuate differences between Levelers and Sharpeners, and between high anxiety and low anxiety

groups.

Hypotheses

In visual size judgment,

1. Accuracy will be a joint function of Leveling-Sharpening and manifest anxiety. a) Sharpeners will show greater accuracy than Levelers. b) Low anxiety subjects will show greater accuracy than high anxiety subjects. c) The effects of Leveling and high anxiety will summate to produce the greatest inaccuracy in judgment, Sharpening and low anxiety will combine to produce the highest accuracy, while other combinations of control and anxiety will be associated with intermediate levels of accuracy. d) High anxiety Levelers may show a greater decrement in accuracy in comparison with low anxiety Levelers than high anxiety Sharpeners will show in comparison with low anxiety Sharpeners.
2. Resistance to interference will be a joint function of Leveling-Sharpening and manifest anxiety. a) Sharpeners will show greater resistance to interference than Levelers. b) Low anxiety subjects will show greater resistance to interference than high anxiety subjects. c) The effects of Leveling and high anxiety will summate to

produce the greatest susceptibility to interference, Sharpening and low anxiety will combine to produce the greatest resistance to interference, while other combinations of control and anxiety will be associated with intermediate degrees of interference effects. d) High anxiety Levelers may show greater interference effects in comparison with low anxiety Levelers than high anxiety Sharpeners will show in comparison with low anxiety Sharpeners.

3. Increased level of difficulty will lead to an accentuation of differences between groups, in both level of accuracy and susceptibility to interference.

Chapter II

PROCEDURE

A Relevant Experimental Design

Postman and Page (94) published a study in which they attempted to demonstrate that "the precision of discriminatory judgments is subject to retroactive inhibition just as are the types of performance commonly studied in memory experiments" (94, p. 367). For this purpose they set up a psychological experiment in which subjects judged the sizes of rectangles according to a conventional retroaction paradigm, as follows:

	Conditions		
	I	II	III
Experimental group	judge width	judge height	judge width
Control group (rest)	judge width	rest	judge width
Control group (practice)	judge width	judge width	judge width

Results indicated that the experimental group declined in precision of judgment on the final series (Condition III) in comparison with its own previous level (Condition I), while neither of the control groups showed a significant drop. The investigators interpreted the decline in accuracy of the experimental group as being due to difficulty in abstracting the appropriate dimension from the stimulus complex in the third series. This difficulty was significantly greater for the subjects in the experimental group since they had acquired a set to judge both dimensions, and their performance was accordingly impaired by incompatible response tendencies.

Levelers and Sharpeners differ in the accuracy with which they judge squares, and have been shown to differ in their ability to abstract figure from ground; consequently they would be expected to differ similarly in judging rectangles and in abstracting the dimension of width from the rectangles in the third series. As regards the anxiety variable, it has been demonstrated that the performance of high anxiety subjects is poor relative to low anxiety subjects in situations involving competing response tendencies as in the third series of judgments: high anxiety subjects have also been shown to have difficulty shifting sets and to be inferior in negative transfer situations. Accordingly the Postman and Page task should be relevant to both the independent variables--Leveling-Sharpening and manifest anxiety--both in

terms of overall accuracy and in terms of shifting of set and of abstracting while faced with competing response tendencies.

Selection of Subjects

Scores on the Manifest Anxiety Scale (115) were obtained from approximately 90 per cent (N=461) of the students in two semesters of introductory psychology at Duke University (Group data are to be found in Appendix II, Table XVIII). Using the conventional cut-off points of the 20th and 80th percentiles, 102 high anxiety subjects were obtained who had scores of 21 or above, and 88 subjects with scores of 8 or below were designated as the low anxiety group. Five of these were eliminated because they had scores of 7 or more on the MMPI Lie Scale which had been included.

From this group volunteers were solicited for participation in the Schematizing Test of Leveling and Sharpening. Since two previous studies had found no relationship between the MAS and Schematizing Test, this pre-selection in terms of MAS scores was not expected to bias the selection of Levelers and Sharpeners. A total of 148 subjects (78 per cent of those available) with normal or corrected vision participated in the Schematizing Test.

The Schematizing Test followed the conventional procedure established by the Menninger group. (A more detailed account of the procedure may be found in Appendix III.) Small groups of subjects were tested in a darkened room. One hundred and fifty white squares were exposed on a black screen for 3 seconds each, with a 9-second interstimulus interval during which the subjects recorded their judgments of the absolute size of each square. There were fourteen different squares ranging from 1.18 inches to 13.73 inches, the difference between any two squares adjacent in the series being capable of being readily discriminated when presented simultaneously. At first only the five smallest squares were shown, each three times over and in fixed random order. On the next series of fifteen the smallest square was omitted, and the next largest included. This procedure was repeated with each series until the entire range was traversed.

In order to eliminate differences in absolute scale units or range used by different subjects, the records were scored in terms of the accuracy with which a square was ranked within a series. As in previous studies, two measures were used (37). Levelers were those who were 1) inaccurate in detecting the position of squares within a series, and also 2) showed considerable loss in accuracy on the middle squares of a series (embedded squares) in comparison with the extremes (salient squares, i. e., the largest or smallest square in the series). Sharpeners were

those who were accurate throughout, showing little loss on the embedded squares. Inconsistent subjects (N=32) on the two measures, who had high overall accuracy for position of squares within a series but low accuracy on the embedded squares, or who had low overall accuracy for position of squares but relatively high accuracy on the embedded squares, were eliminated as being inconsistent with the definition of Leveling and Sharpening. One hundred and sixteen consistent subjects were retained, half Levelers and half Sharpeners. For each subject, the two scores were transformed into standard scores and combined to yield a single Leveling-Sharpening (L. S.) score. Using 27 per cent as the conventional cut-off point for fixing the extremes of a distribution (49), Sharpeners were those who fell in the upper 27 per cent of the L. S. distribution, and Levelers were those who fell in the bottom 27 per cent. This method left a final group of 29 Sharpeners and 30 Levelers. The Schematizing scores of these final subjects were highly similar to those found in previous studies at Kansas and Duke (Appendix III).

Experimental Procedure

A procedure similar to that of Postman and Page was used to test the hypotheses of the present study. (A more detailed account of apparatus and procedure may be found in Appendix IV.)

Test conditions were almost identical with those of the Schematizing Test. One hundred and ten white rectangles were exposed on a black screen for .8 seconds each, with an interstimulus interval of 3.2 seconds. The standard rectangle was 6 7/16 inches wide by 4 13/16 inches high. There were thirteen comparison rectangles, twelve of which differed from the standard in both height and width. Increments and decrements in both height and width ranged from -1 2/16 inches to +1 2/16 inches, arranged symmetrically in 3/16 inch steps with respect to the standard. Variations in width were paired with variations in height in essentially random fashion, with the exception that half of the increases in width were paired with increases in height, and half with decreases in height, the same counterbalancing being used with decreases in width.

Following the Postman and Page method, the standard was exposed after every fifth comparison stimulus. The experimental series comprised 91 judgments, with each of the thirteen stimuli appearing in random order a total of seven times each. The subjects were asked to check each rectangle as wider or narrower than the standard. After the first series there was a two minute rest period. The series was then repeated as before, only this time the subjects were told to judge the rectangles as taller or shorter than the standard. On the third series they again judged width.

Final Subjects

Of the 59 eligible subjects, 49 finally participated in judging the rectangles. Extreme efforts were made to secure every subject but because the experiment was conducted late in the spring with competing final exams and preparations for going home high in the concerns of the subjects there were many distractions that interfered with obtaining 100 per cent of the sample. (Further details are available in Appendix IV.) One subject's record was so extremely deviant from all the others on the initial visual accuracy test that it was eliminated. The final 48 participants fell into the following groups:

		N
I	High Anxiety Levelers	14
II	Low Anxiety Levelers	10
III	High Anxiety Sharpeners	14
IV	Low Anxiety Sharpeners	10

Chapter III

RESULTS

Description of Groups

Taylor MAS scores. The Taylor MAS characteristics on the Leveler and Sharpener groups are shown in Table I. (The raw scores are given in Appendix V, Table XX.)

Table I shows that the MAS scores of Levellers and Sharpeners were highly similar to each other and to the anxiety groups used in a previous study (65). Tests of significance of difference indicated that neither the means nor standard deviations of anxiety scores differed between the Leveler and Sharpener subgroups (all $p > .10$).

Schematizing scores. The Schematizing scores of the groups are shown in Table II. (The raw scores are given in Appendix V, Table XXI.)

Table I

Taylor Manifest Anxiety Scores of Levelers and Sharpeners Participating in the Rectangle Judging Task

	Low Anxiety				High Anxiety			
	N	Mean	S.D.	Range	N	Mean	S.D.	Range
Levelers	10	5.4	1.8	2-8	14	25.7	4.5	21-32
Sharpeners	10	5.8	2.0	3-8	14	26.1	3.7	22-35
Total	20	5.6	1.8	2-8	28	25.9	4.2	21-35
Kubánsky (65)	42	4.2	---	1-7	52	26.4	---	21-42

Table II shows that the differences in the three Schematizing scores between high anxiety and low anxiety subgroups were small. Statistical tests indicated that none of these differences between anxiety subgroups is significantly greater than chance (all $p > .10$).

Tables I and II support the earlier finding of the independence of Leveling-Sharpening and manifest anxiety: Levelers did not differ from Sharpeners in mean MAS or its variability; high anxious groups did not differ from low anxious in the mean or standard deviation of any of the Schematizing scores. As a final check, the Pearson rank order correlation between L. S.

Table II

Schematizing Scores of Groups Participating in the Rectangle Judging Task

		Ranking Accuracy		Loss of Accuracy		Leveling-Sharpening	
	N	Mean	S.D.	Mean	S.D.	Mean	S.D.
Levelers							
High Anxiety	14	73.8	16.6	47.1	9.7	-0.16	1.13
Low Anxiety	10	70.7	17.4	41.6	5.9	0.07	0.86
d		3.1	-0.8	5.5	3.8	-0.09	0.27
Sharpeners							
High Anxiety	14	125.2	11.4	12.3	6.3	4.43	0.82
Low Anxiety	10	128.0	9.1	11.0	6.7	4.60	0.66
d		-2.8	2.3	1.3	-0.4	-0.17	0.16

scores and MAS was computed for each of the four groups. The obtained correlations, including DuBois' correction for ties (33, p. 313), were: high anxiety Levelers -.03, low anxiety Levelers .03, high anxiety Sharpeners -.29, and low anxiety Sharpeners .13. Correlations of twice the magnitude of the largest would be required for significance with these small groups of subjects (17, 33).

Control for intelligence (ACE). A number of studies have indicated that intelligence is unrelated to Leveling-Sharpening (41, 63, 82, 90, 102), but its relationship to manifest anxiety is less clear (32, 50, 79, 81, 83, 101, 112). In order to rule out the possibility that intelligence differences between our groups might at least partially account for whatever differences might be found in the dependent measures, the available ACE scores of the four groups were compared. A 2x2 analysis of variance of the ACE Total score revealed no main effects of either Leveling-Sharpening or MAS scores, and no interaction (all $p > .10$). The ACE data for the four groups may be seen in Table III.

Table III shows that neither Leveling-Sharpening nor manifest anxiety was related systematically to ACE in the present groups. However, the ACE variance of the low anxiety Sharpener group was significantly smaller than the variances of the high anxiety Leveler group ($p < .05$) and the low anxiety Leveler group ($p < .01$), and the variance for the Sharpener group as a whole was smaller than that for the Leveler group as a whole ($p < .05$).

Sex differences. Since the ratio of male to female was approximately the same for all our groups, any consistent sex difference would not be expected to bias the results based on comparisons of the four groups. However, sex could interact with anxiety as in other studies (26, 67, 111), or with Leveling-Sharpening, or with both variables. The numbers were generally

Table III

American Council on Education (ACE) Test Scores on the Four Experimental Groups

		Levelers	Sharpeners	Total
High anxiety	Mean	124.7	132.0	128.3
	S.D.	22.9	16.8	20.0
	N	13	12	25
Low anxiety	Mean	128.8	123.4	126.1
	S.D.	26.4	9.8	19.5
	N	9	9	18
Total	Mean	126.4	128.5	127.4
	S.D.	23.8	14.7	19.6
	N	22	21	43
Spielberger (112)	Mean			124.5
	S.D.			25.1
	N			1142

too small for a formal statistical test of these possibilities, but an examination of the mean scores showed very little difference between males and females in either MAS or L. S. scores except in one instance out of eight comparisons. These data are presented in Table IV.

Summary of descriptive data. The two selection distributions were found to be independent, and highly comparable to those obtained in numerous other studies. Levelers did not differ from Sharpeners in manifest anxiety scores; the anxiety groups did

Table IV

Mean Scores by Males and Females on the Manifest Anxiety Scale and Leveling-Sharpening

	MAS		L.S.	
	Male	Female	Male	Female
Group I	24.4	27.5	1.7	2.0
Group II	5.3	6.0	2.0	3.2
Group III	25.9	26.6	6.7	6.0
Group IV	5.8	5.8	6.7	6.5

not differ in Schematizing scores; the four groups did not differ in mean ACE scores (though there were group variability differences); sex appeared to have no significant influence on either of the independent variables. Accordingly what significant relationships are found between our two independent variables and the various dependent variables cannot reasonably be attributed to bias in the selection procedures themselves (interactions between MAS and L. S.), or to intelligence (ACE), or sex.

Analysis of Results

The psychological function. The function expressing the general relationship of percentage of "wider" responses to the width of the rectangles in terms of deviation from the standard is depicted in Figure 1, and an approximate ogive has been drawn freehand.

Measures. The two measures of accuracy of visual size discrimination which were initially employed had been used by Postman and Page (94) in their psychophysical experiment. These were the Point of Subjective Equality (PSE), and the Standard Deviation (SD). The PSE is the central tendency of a subject's judgments, measured in the present experiment by the arithmetic mean of the uncumulated distribution. Comparison of this measure with the objective midpoint of the physical stimulus series gives a direct measure of a subject's constant error. The SD is a measure of the dispersion or flatness of an ogive curve, and has been considered "a true measure of differential sensitivity" (127, p. 425). Both these measures can be used to test all of the hypotheses raised, with the exception of the two concerning performance as a function of relative difficulty within the task.

The method used to obtain these measures is described by Guilford (34), and attributed to Spearman (106). An examination of the raw scores for individuals showed that in many cases the

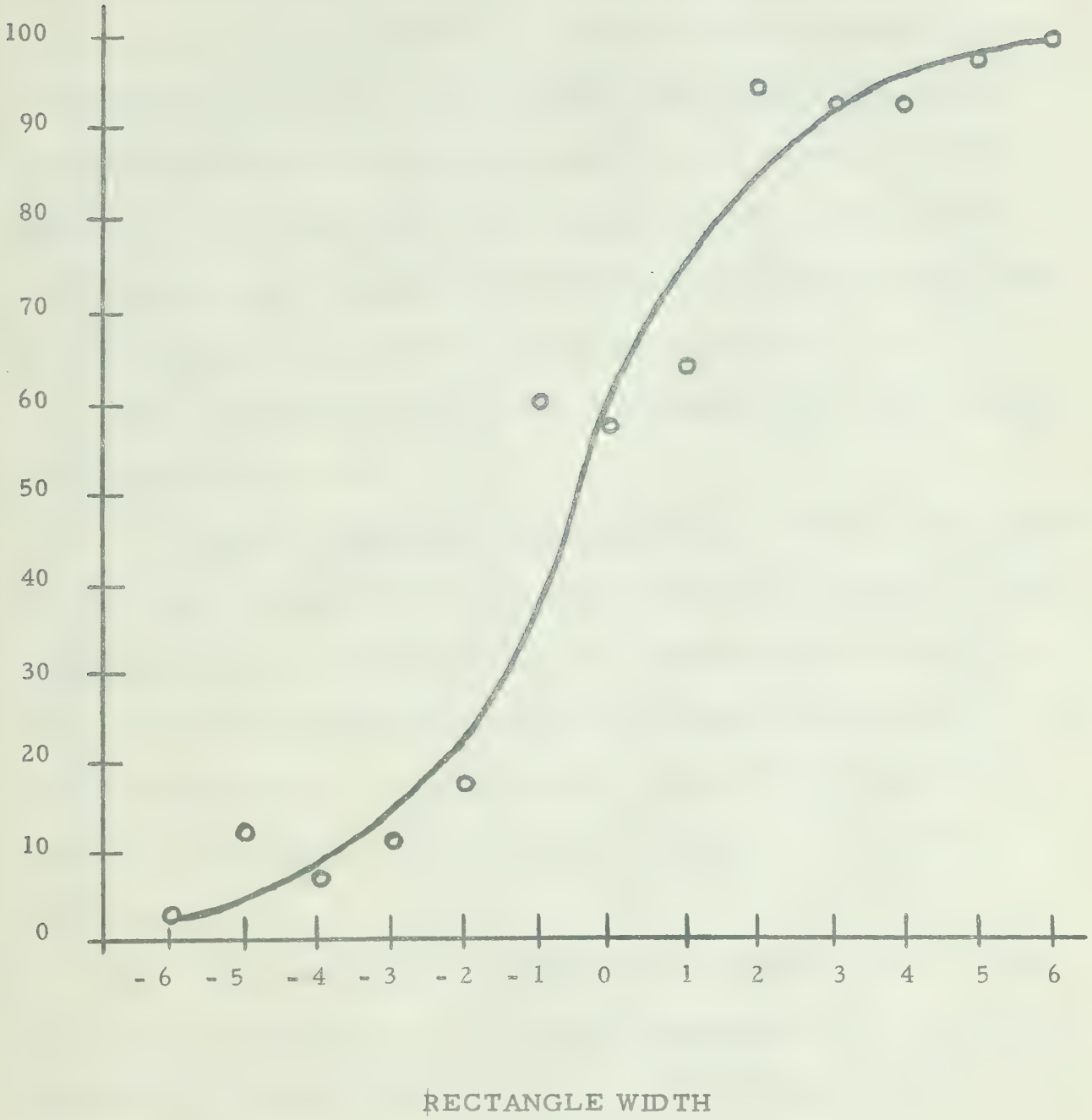

Fig. 1. Percentage of "wider" responses as a function of width of rectangles.

data deviated markedly from normality and could not be described very well by an ogive. Graphic and interpolation methods were ruled out by this instability in the data of many individuals. The Spearman procedure seemed the most appropriate of existing standard psychophysical methods, insofar as a reasonably large number of stimuli had been used, proportions of 0 and 1.0 had been obtained, and negative frequencies (representing inversions in the data) could be easily handled by this method (34).

Each measure was analyzed by a Lindquist Type III analysis of variance design (72).

1. Point of subjective equality (PSE). The PSE raw scores on which the analysis was based may be found in Appendix V, Table XXII. In the first analysis, the two between-subjects factors were Leveling-Sharpening and High Anxiety-Low Anxiety; the within-subjects factor consisted of the Pre- and Post-Interpolation measures. The summary table of this analysis is presented in Table V.

The analysis yielded no significant effects of any of the variables on the PSE, with the possible exception of a suggestive interaction between anxiety and pre- and post-interpolation ($.05 < .10$). A Bartlett test for homogeneity of variance for the eight cells of the analysis indicated that homogeneity had to be rejected beyond the .001 level of confidence (chi-square equals 27.73). Since no valid transformation of these data was possible

Table V

Summary Table of Analysis of Variance of Point of Subjective Equality (PSE) Scores

Source	Sum Squares	df	Mean Square	F
Between Ss	4,964.24	47		
B (Le-Sh)	225.09	1	225.09	2.11
C (HA-LA)	4.22	1	4.22	----
BC	36.67	1	36.67	----
error (b)	4,698.26	44	106.78	
Within Ss	1,387.50	48		
A (Pre-Post)	0.51	1	0.51	----
AB	1.76	1	1.76	----
AC	86.46	1	86.46	2.93
ABC	0.90	1	0.90	----
error (w)	1,297.87	44	29.50	
Total	6,673.16	95		

(72, pp. 88-89), Lindquist's recommendation that the significance level required should be set twice as high was followed. By this criterion the suggestive interaction above had to be disregarded as nonsignificant.

The mean PSE for the total group was -0.11 inches.

The pre- and post-interpolation data were combined, and the heterogeneity of variance remained significant. Tests of differences between the variances showed that the variance of the PSE for Levelers was significently greater than that of the Sharpeners, beyond the .01 level of confidence. Variance for the high anxiety Levelers was significantly larger than that of the high anxiety Sharpeners beyond the .02 level; the low anxiety subgroups differed between the .05 and .10 level. The variance of the high anxiety subjects did not differ from that of the low anxiety subjects, when Levelers and Sharpeners were combined, or when compared within Leveler or Sharpener groups.

2. Standard deviation (SD). The SD raw scores on which the analysis was based may be found in Appendix V, Table XXIII. The factors were the same as for the PSE analysis. The summary table of this analysis is presented in Table VI.

The main effect of Leveling-Sharpening was significant well beyond the .001 level of significance. There were two other F ratios larger than 1: the main effect of anxiety, and of pre- and post-tests. These ratios just failed to reach significance at the 10 per cent level, and were therefore excluded from more detailed analysis. The F ratios for all interactions were less than 1.

Table VI

Summary Table of Analysis of Variance of Standard Deviation (SD) Scores

Source	Sum Squares	df	Mean Square	F
Between Ss	539,665.24	47		
B (Le-Sh)	196,113.76	1	196,113.76	26.70**
C (HA-LA)	19,851.16	1	19,851.16	2.71
BC	989.08	1	989.08	-----
error (b)	322,711.24	44	7,334.35	
Within Ss	187,039.50	48		
A (Pre-Post)	10,901.38	1	10,901.38	2.76
AB	86.22	1	86.22	-----
AC	2,272.04	1	2,272.04	-----
ABC	20.94	1	20.94	-----
error (w)	173,758.92	44	3,949.07	
Total	766,709.99	95		

** significant beyond .001 level.

A Bartlett test for homogeneity of variance for the eight cells of the analysis indicated that homogeneity had to be rejected beyond the .01 level (chi-square equals 20.50). Since the means and variances were related in an approximately linear manner, the SD scores were transformed to logarithms (72, 89). The

transformed scores may be found in Appendix V, Table XXIV. A Bartlett test of the homogeneity of variance of these transformed scores indicated that the significant heterogeneity in the raw data had been eliminated (chi-square equals 8.48, significant only between the .20 and .30 levels).

The summary table of the analysis of the transformed SD scores is presented in Table VII. The results of this analysis were essentially the same as those of the prior analysis of the raw data. The main effect of Leveling-Sharpening was significant well beyond the .001 level of significance. The main effects of anxiety and pre- and post-test fell between the .05 and .10 level, and were of only suggestive significance. As before, none of the F ratios for the interaction terms were greater than 1. Since the results of the analysis of the transformed data were essentially the same as those from the analysis of the raw data, the original findings appeared to be valid despite the heterogeneity of the raw SD scores. Accordingly, the subsequent tests were based upon the untransformed data.

The mean SD scores of the four groups under the two conditions are reported in Table VIII.

The pre- and post-interpolation SD data were combined, since the differences between these two conditions were not significant nor did the conditions interact in any significant

Table VII

Summary Table of Analysis of Variance of Log Standard Deviation (SD) Scores

Source	Sum Squares	df	Mean Square	F
Between Ss	12,903.96	47		
B (Le-Sh)	4,873.50	1	4,873.50	28.66**
C (HA-LA)	545.63	1	545.63	3.21
BC	1.54	1	1.54	-----
error (b)	7,483.29	44	170.07	
Within Ss	5,459.00	48		
A (Pre-Post)	376.04	1	376.04	3.26
AB	1.50	1	1.50	-----
AC	17.43	1	17.43	-----
ABC	2.75	1	2.75	-----
error (w)	5,061.28	44	115.03	
Total	18,362.96	95		

** significant beyond the .001 level.

Table VIII

Mean SD Scores of the Four Groups Under Pre- and Post-Interpolation Conditions

	Levelers		Sharpeners	
	Pre	Post	Pre	Post
High Anxiety	3.45	3.14	2.48	2.20
Low Anxiety	3.00	2.88	2.15	2.08

manner with the other variables. The differences between Levelers and Sharpeners were computed separately for the high anxiety and low anxiety groups. In each case the *t* tests of the significance of difference were significant beyond the .001 level of confidence. Levelers were found to have consistently greater mean SD scores than Sharpeners.

The variances of the four groups were still significantly heterogeneous when the scores for the two conditions were combined. As with the PSE data, the variance of the SD for Levelers was significantly greater than that of Sharpeners beyond the .01 level of confidence. The variance differences between Levelers and Sharpeners were computed separately for the high anxiety and low anxiety subgroups. The *F* test of the significance of these differences indicated that the high anxiety Leveler group had a

significantly greater SD variance than the high anxiety Sharpener group, beyond the .01 level; the variance of the low anxiety Levelers did not differ from that of the low anxiety Sharpeners however. As in the PSE data, the significantly greater SD variance of the Leveler group as a whole appeared to be due primarily to differences in the high anxiety subgroups. The variance of the high anxiety subjects did not differ from that of the low anxiety subjects either within Leveler and Sharpener groups or when Levelers and Sharpeners were combined.

"Number correct." Since the raw scores of many of the individual subjects could not be very well described as normally distributed, a measure consisting of the number of stimuli correctly identified as wider or narrower than the standard was computed. This measure gives each correct response a weight of 1, regardless of its degree of difference from the standard, and thus might avoid the possible inflation that could occur in the SD score due to one or two errors on stimuli distant from the standard.

The "number correct" scores may be found in Appendix V, Table XXV. The factors in the Type III analysis were the same as before. The summary table for this analysis is presented in Table IX.

The main effect of Leveling-Sharpening was significant well beyond the .001 level of significance. The effect of anxiety was

Table IX

Summary Table of Analysis of Variance of "Number Correct" Score

Source	Sum Squares	df	Mean Square	F
Between Ss	2,340.66	47		
B (Le-Sh)	698.76	1	698.76	20.77**
C (HA-LA)	160.78	1	160.78	4.78*
BC	1.04	1	1.04	-----
error (b)	1,480.08	44	33.64	
Within Ss	629.50	48		
A (Pre-Post)	46.76	1	46.76	3.60
AB	0.10	1	.10	-----
AC	0.37	1	.37	-----
ABC	10.55	1	10.55	-----
error (w)	571.72	44	12.99	
Total	2,970.16	95		

** significant beyond .001 level.
* significant beyond .05 level.

significant beyond the .05 level. The effect of pre- and post-interpolation was significant between the .05 and .10 level. None

of the F ratios for the interaction terms was greater than 1.

A Bartlett test of homogeneity of variance for the eight cells of the analysis indicated that homogeneity had to be rejected beyond the .01 level (chi-square equals 19.83). In an attempt to reduce this heterogeneity, an arcsin transformation was used.[1] The "number correct" scores were first changed into proportions, and these were subsequently transformed into radians (122, pp. 423-424, 479). These transformed scores may be found in Appendix V, Table XXVI. A Bartlett test of the homogeneity of variance of these transformed scores indicated that the significant heterogeneity in the raw data had been eliminated (chi-square equals 10.72, significant only between the .10 and .20 levels).

The summary table of the analysis of the transformed "number correct" scores is presented in Table X. The results of this analysis were the same as those of the prior analysis of the raw data: Levelers differed from Sharpeners beyond the .001 level, high anxiety subjects differed from low anxiety subjects beyond the .05 level, pre- and post-interpolation scores differed between .05 and .10, and none of the interactions even approached

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1. Our thanks to Dr. Kellogg Wilson for recommending this procedure.

Table X

Summary Table of Analysis of Variance of Transformed "Number Correct" Scores

Source	Sum Squares	df	Mean Squares	F
Between Ss	26,565.83	47		
B (Le-Sh)	8,066.66	1	8,066.66	21.43**
C (HA-LA)	1,938.30	1	1,938.30	5.15*
BC	0.81	1	0.81	-----
error (b)	16,560.06	44	376.36	
Within Ss	8,196.00	48		
A (Pre-Post)	661.53	1	661.53	3.91
AB	0.00	1	0.00	-----
AC	0.14	1	0.14	-----
ABC	86.79	1	86.79	-----
error (w)	7,447.54	44	169.26	
Total	34,761.83	95		

** significant beyond .001 level.
* significant beyond .05 level.

significance.

Scores on the two parts of the test were combined, since the difference between them failed to reach an acceptable level

of confidence. The means and variances of these combined scores are reported in Table XI.

Table XI

Means and Variances of the "Number Correct" Score for the Four Groups

	Levelers	Sharpeners	p	
		Means		
High Anxiety	136.4	147.6	<.01	<.001
Low Anxiety	142.1	152.4	<.01	
p	<.10	<.05		
		<.05		
		Variances		
High Anxiety	139.1	35.5	<.05	<.05
Low Anxiety	46.8	29.8	>.10	
p	>.10	>.10		
		>.10		

It may be seen in Table XI that the mean differences between Levelers and Sharpeners were equally reliable within both high anxiety and low anxiety subgroups. Levelers also had significantly greater variance overall, but this difference was not reliable when low anxious Levelers were compared with low anxious Sharpeners. The mean differences between anxiety groups were significant only within the Sharpener group. The variances were not significantly different for anxiety groups. These results as a whole were in close agreement with those based upon the SD scores, with minor differences in significance levels. Because of this apparent high similarity between the "number correct" results and SD results, the correlation between the two measures was computed. The obtained correlation was -.92, indicating a very high relationship between the two.

Influence of initial level. In previous chapters it was noted that a significant interaction might occur between groups and conditions as a function of original level alone, and not necessarily because the groups were inherently differentially susceptible to the interpolated interference. The effect of initial level could be taken into account by means of an analysis of covariance design. Since no such interaction appeared in the analyses, there seemed at first to be little point in considering the influence of original level. However because

the level of accuracy was generally so high for the Rectangles Test, as assessed by the "number correct" score (mean accuracy for all groups equals 86 per cent with a range from 63 per cent to 94 per cent), it seemed possible that there was a "ceiling effect" in the task which could have prevented an interaction from occurring. Since there was a slight tendency for all groups to improve on the post-interpolation series, it might have been that the groups having the highest initial scores (e. g., Group IV, the Low Anxiety Sharpeners) might have had the least improvement because they had very high accuracy even in the first series. This could result in a negative correlation between initial level and extent of change or improvement.

To test this possibility, product moment correlations were computed between initial level and degree of improvement, for each of the groups separately, and for the total 48 subjects. The improvement scores consisted of the score on the first series (pre-interpolation) minus the score on the second series (post-interpolation) for the PSE and SD data, and the reverse for the "number correct" data. These individual improvement scores may be found in Appendix V, Table XXVII. Negative numbers were eliminated by the addition of a constant. The correlations between initial level and extent of change are reported in Table XII.

It is apparent from Table XII that for all three measures

Table XII

Product Moment Correlations Between Initial Level and Extent of Change (Improvement) from the Pre-Interpolation to the Post-Interpolation Series

	PSE	SD	"Number Correct"
Group I (HA-Le)	.13	.51	-.46
Group II (LA-Le)	.18	.80**	-.77**
Group III (HA-Sh)	.50	.66**	-.75**
Group IV (LA-Sh)	-.01	.20	.08
Total (N=48)	.22	.48**	-.48**

* beyond .05 level.
** beyond the .01 level.

there was a positive relationship between degree of error on the initial series and the extent of improvement from the initial series to the post-interpolation series. For the total group this relationship was significant for both the SD and "number correct" scores, beyond the .01 level of confidence. For these same measures, the relationship was significant at the .01 level for two of the groups, and just failed to reach significance at the .05 level for the third. The insignificant correlation for Group IV may have been due largely to its high homogeneity, since

all scores of this group were near the maximum level of accuracy, and the scores of individuals in the group differed very little from each other.

It seemed possible, on the basis of these correlations, that if the effect of original level could be statistically eliminated, a significant interaction in the expected direction might be found. Those with the higher initial level might show a differentially greater increase than those with a lower initial level, if the restraining effect of the "ceiling" or maximum accuracy level were eliminated. The possibility of using an analysis of covariance to test this was ruled out by the failure to fulfill the assumption that the correlation is the same for all treatment populations (72, p. 323). Accordingly, the possibility that an interaction might exist between groups and conditions if it were not for the ceiling effect, must remain an open question.

Hypotheses relating to difficulty level. It was hypothesized, on the basis of theory and findings related to both Leveling-Sharpening and anxiety, that the predicted effects in the experiment would be more pronounced for the difficult portions of the task. Since difficulty had not been introduced as a specific experimental variable in the original design, levels of difficulty had to be determined from the data. In general, the smaller the difference between the comparison stimulus and the standard, the greater the difficulty in making a correct judgment of that

stimulus.

The number of errors as a function of stimulus difference from the standard is depicted in Figure 2. It is clear from this figure that there was a large difference in number of errors between the two stimuli nearest in size to the standard and those more deviant from the standard. It was decided to arbitrarily characterize the two stimuli with the greater number of errors as "difficult" (rectangles -1 and +1), and the other stimuli, on which fewer errors were made, as "easy" (rectangles -2 to -6 and +2 to +6). No other possible breakdown presented itself.

For purposes of analysis, it would seem best to compare the two most difficult with the two easiest stimuli. However, it was apparent upon examination of the data that a distribution of scores on the two easiest rectangles contained a large number of zeros, and deviated markedly from normality. When the scores on all ten easy stimuli were combined, a more normal distribution was obtained. Since these ten rectangles all yielded fairly similar error scores, it was felt that their combination would still yield a representative "easy" measure.

The raw scores used in the analysis may be found in Appendix V, Table XXVIII. The data were analyzed in terms of four variables by a Lindquist Type VI mixed design (72) with an additional between-subjects factor. Levelers vs. Sharpeners (C) and High Anxiety vs. Low Anxiety (D) were the between-subjects factors as

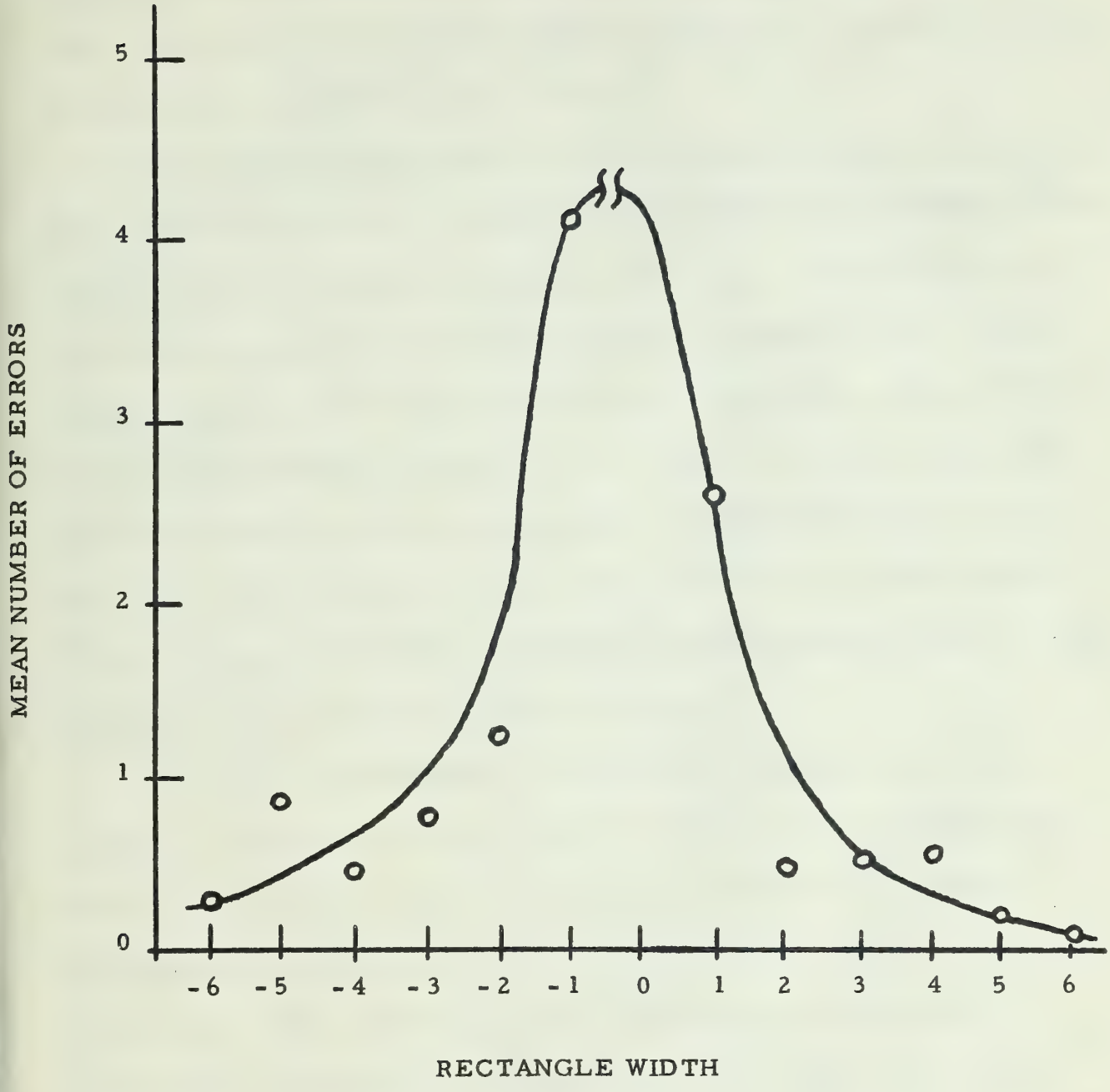

Fig. 2. Mean number of errors as a function of width of rectangles.

before; Pre- and Post-interpolation tasks (A) and Difficult vs. Easy portions (B) were within-subjects factors. A summary of this analysis is presented in Table XIII.

The analysis of the error scores indicated that Levelers and Sharpeners differed well beyond the .001 level of confidence; the anxiety groups differed beyond the .05 level. These results were of course in agreement with the previous analysis of the "number correct" score. The scores on the easy versus the difficult parts of the tasks differed beyond the .05 level. Pre- and post-interpolation conditions were not significantly different ($p > .10$). The only other F ratios greater than 1 were for the two simple interactions of difficulty with Leveling-Sharpening, and with anxiety, but these were far from significant.

The means and variances of the error scores for the four groups on easy and difficult parts of the task are presented in Table XIV, and the means are depicted graphically in Figure 3. The order of the groups was as predicted: high anxiety Levelers had the greatest amount of error in visual size discrimination, low anxiety Sharpeners the least error, with the other groups falling in between.

Difficulty did not significantly affect the differences between groups, contrary to expectation. Inspection of the graph, however, suggested that there was a slight tendency for the anxiety subgroups to be more widely separated on the difficult

Table XIII

Summary Table of Analysis of Variance of Error Scores for Difficult and Easy Parts of the Rectangles Test

Source	df	Mean Square	F
C (Le-Sh)	1	349.38	20.76**
D (HA-LA)	1	80.39	4.78*
CD	1	0.52	-----
error (b)	44	16.83	
A (Pre-Post)	1	23.38	2.82
AC	1	0.05	-----
AD	1	0.18	-----
ACD	1	5.32	-----
$error_1$ (w)	44	8.28	
B (Diff.-Easy)	1	109.51	5.66*
BC	1	47.01	2.43
BD	1	23.93	1.24
BCD	1	0.14	-----
$error_2$ (w)	44	19.34	
AB	1	0.01	-----
ABC	1	0.63	-----
ABD	1	0.45	-----
ABCD	1	0.05	-----
$error_3$ (w)	44	8.88	

** beyond .001 level.
* beyond .05

Table XIV

Means and Variances of Error Scores on Difficult and Easy Parts of the Rectangle Comparison Task

	Levelers		Sharpeners	
	Mean	Variance	Mean	Variance
		Difficult		
High Anxiety	16.8	33.4	13.3	34.1
Low Anxiety	12.7	18.7	9.4	27.2
		Easy		
High Anxiety	14.7	142.8	7.1	9.8
Low Anxiety	13.2	20.8	6.2	22.4

part of the test, while Levelers and Sharpeners were less widely separated under the difficult conditions. The significance of differences for both means and variances of the groups, computed separately for difficult and for each portions of the Rectangles Test, are reported in Table XV.

The data in Table XV indicate that the differences between Levelers and Sharpeners were at a higher significance level for the easy part of the task. For the anxiety difference, the opposite was true; although the original analysis showed that the

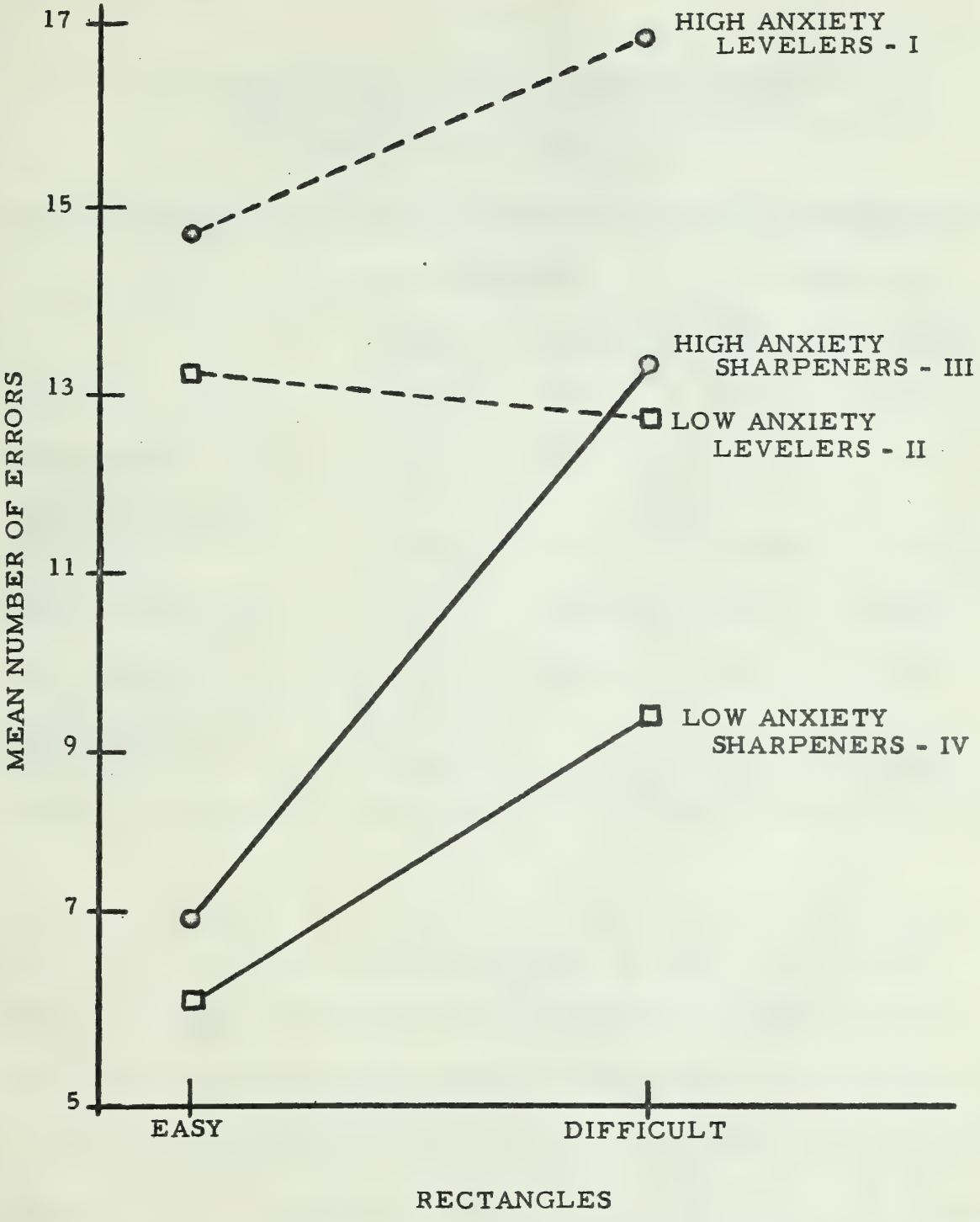

Fig. 3. Mean error scores of high and low anxiety Levelers and Sharpeners on easy and difficult parts of the rectangle comparison task.

Table XV

The Significance of Differences in Means and Variances of Error Scores for the Major Experimental Subgroups

	Difficult		Easy	
	Mean	Variance	Mean	Variance
Levelers	15.1	30.6	14.1	89.5
Sharpeners	11.7	33.9	6.7	16.8
Significance of Difference	<.05	----	<.005	<.001
High Anxiety	15.1	35.6	10.9	90.6
Low Anxiety	11.0	24.6	9.7	33.4
Significance of Difference	<.01	----	----	<.05

main effect of anxiety was significant at the .05 level, the further breakdown showed that the differences between anxiety groups were significant only for the difficult part of the task.

This was further demonstrated by the t tests of differences between each of the groups, presented in Table XVI. The Leveler-Sharpener subgroups (I-III, II-IV) differed significantly only for the easy part of the task, while anxiety subgroups (I-II, III-IV) differed significantly only for the difficult portions.

Table XVI

Table of t Tests of Significance of Differences Between Each of the Groups on Difficult and Easy Parts of the Rectangle Comparison Task

		Group I	Group II	Group III
Group II	Diff.	2.02*		
	Easy	0.43		
Group III	Diff.	1.59	-0.32	
	Easy	2.31*	3.67**	
Group IV	Diff.	3.30**	1.54	1.74*
	Easy	2.41*	3.37**	0.51

* significant beyond .05 level.
** significant beyond .01 level.

Thus the differences between groups in the accuracy of visual size judgments did seem to be affected by difficulty level, though this was a more complex relationship than was predicted.

Retroaction and interference. None of the initial measures used showed any significant difference between pre- and post-interpolation series nor any interactions with series. It seemed reasonable however to raise the possibility that the interpolated task, which was designed to have interfering qualities, might have influenced only the early portion of the post-interpolation

series. Since the task was relatively easy overall, any interference effects might have been soon overcome, so that the total scores on the post-interpolation series would not have reflected the small initial effects of interference.

To test this possibility, retroaction scores were computed which consisted of the difference between the number correctly judged on the last two trials of the pre-interpolation task and the first two trials of the post-interpolation series. These retroaction scores may be found in Appendix V, Table XXIX. A 2x2 analysis of variance was performed on these scores, and the summary of the analysis is given in Table XVII. It was apparent from this analysis that there were no differences between groups in this retroaction measure.

It was observed that in addition to those who did more poorly after the interpolated task there were a number of individuals in each group who had higher scores on the first two trials of the post-interpolation series than on the last two trials of the pre-interpolation series, and a number who had the same score. A nonparametric test was made of the differences between the groups in terms of numbers of individuals who had lower, higher, or the same score on the two post-interference trials. The chi-square of 1.63 with six degrees of freedom could occur more than 95 times out of 100 by chance, again show-

Table XVII

Summary Table of Analysis of Variance of Retroaction Scores of the Four Groups

Source	Sum Squares	df	Mean Square	F
A (Le-Sh)	0.02	1	0.02	----
B (HA-LA)	0.50	1	0.50	----
AB	2.67	1	2.67	----
within	152.79	44	3.47	
Total	155.98	47		

ing no differences between groups in response to the interpolated task.

Learning. Although no explicit hypotheses had been introduced concerning possible differences in learning between the groups, the investigation of these learning curves might aid in the interpretation of the experiment as a whole. The learning score used was the difference in number correct between the first two and last two trials of the first series. The raw scores used for this measure may be found in Appendix V, Table XXX.

A 2x2 analysis of variance indicated that there were no differences between groups in this learning score, and no interaction between groups. Since it seemed likely that even here the

initially high scores might prevent any significant rise in scores, the amount of improvement was correlated with initial level of accuracy. The rank order correlation for groups I through IV were -.32, -.72, -.80, and -.26 respectively, and the product moment correlation for the total group of subjects was -.60. The correlations for the total group and for group III were significant beyond the .01 level; that for group II was significant at the .05 level. It was apparent that even in moving from trials 1 and 2 of the first series to trials 6 and 7 of that series, improvement was limited by initial level. As with the similar findings regarding the differences between pre- and post-interpolation series, it seemed that possible differential rates of improvement for the four groups may have been prevented by a "ceiling" effect in a task which was very easy even at the beginning.

Intertrial variability. Although there was no significant differences between the four groups in mean learning scores for the pre-interpolation series, it was considered that the Levelers might show greater variability of accuracy across the seven trials, somewhat similar to Siegal's recent finding (102) for verbal material. The measure of variability used was the variance, computed over the seven trials for each individual. These scores may be found in Appendix V, Table XXXI. A 2x2 analysis of variance of these scores revealed no significant effects of

Leveling-Sharpening, anxiety, or their interaction on inter-trial variability (all F ratios less than 1).

Summary

The groups used in this study were selected according to conventional criteria, and their scores closely approximated those obtained in similar previous studies at Duke and elsewhere. The two selection measures were not related in any discernible manner, and they were also unrelated to intelligence or sex differences.

1. Levelers did not differ from Sharpeners in PSE, but they had significantly greater SD (slope) scores, and significantly lower "number correct" scores. Levelers had significantly greater group variance than Sharpeners on all three measures.

2. High anxiety subjects did not differ from low anxiety subjects in PSE, but had suggestively greater SD scores, and significantly lower "number correct" scores. The high anxiety subjects did not differ from low anxiety subjects in group variance on any of the three measures.

3. There were no interactions between Leveling-Sharpening and anxiety in PSE, SD, or "number correct" scores.

4. Scores on the post-interpolation series did not differ from those on the pre-interpolation series, nor was there any

interaction between series and the experimental groups, for the three measures.

5. Significant negative correlations between original level of judgmental accuracy and extent of improvement for SD and "number correct" scores suggested that the level of difficulty of the task was so low as to restrict the possibility of differential rates of improvement for the experimental groups.

6. There was no significant interaction of difficulty level with groups in the analysis of variance, but t tests based on individual subgroups showed that Levelers differed from Sharpeners most significantly on the easy portions of the task, whereas anxiety groups differed significantly only on the difficult parts of the task. Anxiety subgroups within the Leveler and Sharpener groups differed only on difficult rectangles; Leveler and Sharpener subgroups within anxiety groups differed only on easy rectangles.

7. Three further measures--retroaction, learning, and intertrial variability--showed no significant differences between groups.

Chapter IV

DISCUSSION

This experiment was undertaken in an attempt to delineate more clearly the functioning of the cognitive control principle of Leveling-Sharpening in psychophysical judgment, including a situation designed to assess interference effects. It also attempted to investigate the possible influence of this cognitive control on the operation of the motivational variable of manifest anxiety in the same task. The task was specifically selected in terms of the probability of its being sensitive to both the Leveling-Sharpening and manifest anxiety variables, as suggested by theory and previous research. The hypotheses were grouped under two main headings: those relating to accuracy of visual size judgment, and those relating to the effects of interpolated interference on accuracy. The effects of level of difficulty were also examined, along with a number of other more incidental fac-

tors. The discussion will treat each of these major topics in order, in each case dealing first with the effects of Leveling-Sharpening, then with manifest anxiety, and finally their joint effects.

Accuracy

Leveling-Sharpening. In accord with the predictions stated, Sharpeners showed significantly higher accuracy of visual size judgment in the Rectangles Test than did Levelers, on two of the three measures used to assess accuracy. This finding of the hypothesized differences between Levelers and Sharpeners in overall accuracy on the Rectangles Test permits the extension of this cognitive control principle to the new conditions that arefound in the second task.

1. One important conclusion is that the Leveling and Sharpening behaviors are stable over a period of time. The rectangle task was administered from three to five months after the Schematizing Test, and the differences between groups remained very highly significant. This finding is of considerable value, inasmuch as the stability of this control until now has only been assumed, no repeat reliability studies having appeared at the time of this report.

2. The conditions involved in the Rectangles Test provide confirmation of the findings of the preliminary study that Leveling-Sharpening is distinct from "shifting." Klein originally seemed to believe that Leveling behavior was due to "adaptive lag" (60), and used the terms "lag or leveling" synonymously (53, p. 339). The error introduced by difficulty in shifting bears no necessary relation to the within-series ordinal ranking upon which the selection of Levelers and Sharpeners is based (37, 39). A subject might shift his reference level very little and his judgments might fall far below the absolute size of the stimulus series and yet still maintain accurate ranking within each series of five stimuli. This has since been recognized by the Menninger group (40, 105).

The present study more definitely establishes the independence of Leveling-Sharpening and shifting or "lagging," in that the highly significant differences between Levelers and Sharpeners have appeared even though no shifting of reference level is involved in the Rectangles Test. This finding is important particularly since the distinction has been overlooked by certain investigators (15, 16) only recently.

3. The finding of no differences between groups in mean PSE indicates that Leveling and Sharpening are not due to tendencies to overestimate or underestimate.

4. Finally, Levelers as a group had significantly higher variance on all three measures than the Sharpeners. The Leveler group appears to be more heterogeneous in its response to the Rectangles Test. This is at least in part due to the fact that some Levelers deviated markedly downward from the mean of the total group; the scores of the Sharpener group were generally high, however, and there was no opportunity for extreme Sharpeners to deviate upward to the same extent. This upholds earlier observations that Levelers are a more heterogeneous group (53).

These findings lend further clarification to the nature of Leveling and Sharpening behaviors. It is apparent that "lagging" as observed by Klein in the Schematizing test is not essential to the appearance of these behaviors, and tendencies to overestimate or underestimate are also irrelevant. It might then be asked what the essential nature of Leveling-Sharpening appears to be. The major feature seems to be the accuracy with which successively presented visual stimuli are discriminated from each other and from a standard. Holzman has drawn the generalization that "Sharpening refers to a propensity to maximize stimulus differences," while Levelers "tend to minimize such differences and to prefer the experience of sameness to that of difference" (39, p. 376). He also refers to the Levelers' need for strong frames of reference and their inability to sustain a perceptual organization over time. The present study offered a frequently recurring

frame of reference, but the differences between Levelers and Sharpeners still appeared. If Holzman's statement is correct, the Leveler's capacity to retain the frame of reference must be very short lived--in the present experiment somewhere between about 3 and 20 seconds. It could be observed here that the importance of the retention of the frame of reference could be tested by setting up a range of time intervals from zero (simultaneous exposure) to several minutes.

Various investigators have held that Leveling and Sharpening behaviors are due to a "characteristic outlook" or "orientation" (95b), a "propensity" or to "preferred modes of solving problems" (37). Holzman has reported that Levelers and Sharpeners do not differ in visual acuity (42) or absence of ability, but rather in their "preferred styles of organizing" (39, p. 391). On the other hand Klein has spoken of characteristic differences in the organization of brain traces (36), which appear at the "level of process formation" (55), as though these were almost innate or predisposing characteristics of the organism. The extent to which these cognitive controls may be due to innate characteristics or to learned behaviors remains to be explored. Motivational differences between Levelers and Sharpeners may also be an important factor.

Manifest anxiety. In accord with the predictions stated, low anxiety subjects showed greater accuracy than high anxiety

subjects, on the Rectangles Test as a whole. This finding is in accord with clinical conceptions of anxiety which describe anxiety as a disruptive or disorganizing state of the organism (27, 35, 74). It is also in keeping with a number of studies which have shown that anxiety impairs sensory discrimination and judgment (30, 35, 36, 65, 66). Although it offers support for the characterization of the MAS as a measure of disruptive drive, it is not a test of Hull-Spence-Taylor drive theory since the number and strength of competing response tendencies cannot be assessed (116). Also, whether the impaired performance of highly anxious subjects is due to lowered acuity, fluctuating attention, or other factors, cannot be determined from the present data.

The question may be raised as to why anxiety differences appeared in the Rectangles Test, while they were absent in the highly similar Schematizing Test. There were certain differences in the stimulus situations which may be relevant. One is the difference in exposure times: 3 seconds <u>on</u> and 9 <u>off</u> in the Schematizing Test, 0.8 seconds <u>on</u> and 3.2 seconds <u>off</u> in the Rectangles Test. It is possible that the more rapid pacing of stimulus and response interacted with manifest anxiety to produce the differences between groups. Taylor herself has speculated that "under longer time intervals, stress upon <u>S</u>s, and hence upon differences in emotionality between anxious and nonanxious, is minimized" (116, p. 309). In the same review it is made clear

that the issue of whether MAS measures a chronic emotional state or reflects different potentialities for anxiety arousal, is far from settled.

It is reasonable to assume that the MAS scores of the experimental subjects would have been essentially the same after the three to five month interval, since studies have shown the MAS to have high repeat reliability. However, if Taylor scores reflect anxiety proneness, it is possible that the subjects were all under greater stress during the Rectangles Test, and that this stress had different consequences in anxious and nonanxious subjects. It may not be irrelevant that the second test was run shortly before final examinations. It was also noted that the temperature was higher during the Rectangles Test, to the point where some subjects complained of discomfort. As a final speculation, it was observed that many of the students were most concerned as to why the experimenter had gone to so much trouble to have them return for the second experiment; their participation in the Schematizing Test had been voluntary and much more casual. Sarason and Mandler (99) have pointed of the disruptive effects of ego-involvement in high anxiety subjects, and something similar may have been operating here.

Joint effects of Leveling-Sharpening and manifest anxiety. The hypothesis that accuracy of visual size judgment is a joint function of Leveling-Sharpening and manifest anxiety was con-

firmed. Table XI shows that the groups were ordered according to prediction: low anxiety Sharpeners had the highest accuracy, high anxiety Levelers showed the poorest accuracy, and the other two groups were intermediate to these. In the rectangle judging task, the inaccuracy-producing factors of Leveling and high manifest anxiety summated. The hypothesis that anxiety would affect accuracy differentially for Levelers and Sharpeners was rejected.

It had been speculated that Levelers might show greater impairment in accuracy under conditions of high manifest anxiety than would Sharpeners. This was based primarily upon the Gestalt neurophysiological theory introduced to explain Leveling-Sharpening phenomena. The theory postulated that trace boundaries are weaker in Levelers, permitting greater diffusion, and leading to more rapid dissipation of differentials which serve to keep the cortical representation of objects distinct. On the basis of this theory the present investigator suggested that the tensions of anxiety might diffuse more readily in Levelers, whereas they would be more effectively bound by the Sharpeners' stronger trace boundaries. The flood of excitation might lead to differentially greater inaccuracy in Levelers.

This formulation may still have merit, but more careful consideration of the nature of the "anxiety" under discussion will show that this hypothesis could not be tested in the present experiment, since subjects were not equated in terms of anxiety

(stimulus) input or induced stress, but rather in terms of the self-reported behavioral end-product (response) to some degree of internal stress or discomfort. What was assessed and controlled was the end-product of the diffusion of the internal or stimulus anxiety. Taylor posits that MAS scores are some positive function of internal drive, but the function has not been clearly demonstrated. It is possible that the equivalent manifest anxiety scores of our Levelers and Sharpeners reflect various degrees of internal drive or tension.

A better test of the differential diffusion of energy, tension, or anxiety between Levelers and Sharpeners would require a standard input of stimulation, the dependent variable being some measure of response decrement. The accurate measurement of internal tension is extremely difficult, however, and even standard input does not guarantee a standard level of anxiety.

The empirical results indicate that in accuracy of visual size judgment, the differences between high anxiety and low anxiety subjects is the same regardless of whether they are Levelers or Sharpeners. The two variables retain their independence. This lends support to the repeated assertions of Holzman (38, 41, 42) and our own previous findings (90) that Leveling and Sharpening, as preferred modes of responding to the adaptive requirements of a cognitive task, are distinct from anxiety, which is a drive state associated with a proneness for disrupted behavior.

The present experiment demonstrates that while a knowledge of Leveling and Sharpening cognitive controls does not assist in the prediction of the relative effects of manifest anxiety on visual size judgment, it does show clearly that a more precise prediction of absolute level of accuracy can be made if the cognitive controls are also known. If sampling errors with regard to Leveling-Sharpening should occur in an anxiety experiment, so that most of the high anxiety group were Sharpeners and most of the low anxiety group were Levelers, it is likely that the analysis would show anxiety to have no effect, and the investigator would be led to a false conclusion.

Interference

Leveling-Sharpening. The hypothesis that the accuracy of Levelers would show relatively greater impairment than that of Sharpeners, after an interpolated series of judgments designed to be interfering, was not confirmed. Differences in response of Levelers and Sharpeners to interference were predicted on the basis of theory and empirical data presented by Klein and Holzman (37, 39, 43), and the high similarity of the Postman and Page task to the Schematizing Test was expected to facilitate the appearance of Leveling and Sharpening behaviors.

There seems to be validity for examining closely reasons for the failure to demonstrate the predicted finding. 1) Defects in the experimental design of the Rectangles Test as employed in the present study make it difficult to accept disconfirmation of the hypothesis with certainty. The hypothesis was concerned specifically with differences in the extent of interference effects in Levelers and Sharpeners, yet the data gave no evidence that any interference had actually occurred. Instead of showing a significant decrement in precision after interpolation, as in the original rectangle-judging task, the groups in the present study showed a slight but insignificant improvement in the accuracy measures. The interpolated judgments may have had a relatively interfering effect in comparison with groups who did not have the interpolated series, but it had not been possible to obtain such control groups for the present experiment.

2) A number of differences between the Rectangles Test and the original Postman and Page task may have contributed to the lack of significant post-interpolation decrement in the former. One major variation was in the length of the session. Postman and Page had their subjects give three series of 130 judgments of one dimension, then 130 judgments of the other dimension, and a test series of 130 judgments--requiring over an hour and a half. The Rectangles Test consisted of 91 judgments of one dimension, then 91 of the other, and a test series of the same

number--requiring less than half the time of Postman and Page's task. The original task permitted a much greater fixation of response set, and although the main effect of fatigue was taken into account by appropriate control groups, it may have interacted with interference to produce the final decrement. Subsequent studies should take care to establish the interference effects first, before testing for Leveler-Sharpener differences.

3) Another variable which may have been of significance was the difficulty level of the task as a whole. Mean accuracy on the Rectangles Test for the entire population was 86 per cent -- 83 per cent for Levelers and 89 per cent for Sharpeners. It has been well established in studies with verbal materials that "the better the previous activity itself is discriminated . . . the less it will be confused with the test activity" (92, p. 539) or interpolated activity. Interference is minimal when the two sets of stimuli are easily discriminated. The high level of accuracy on the Rectangles Test suggests that such may have been the case here.

4) If interference was negligible and the discrimination easy, the individual differences in response to interpolation would not have been likely to appear. It would seem to be true, as Krathwohl and Cronbach point out, that "any change which makes the task easier will leave less room for individual differences in perceptual habits to affect the performance" (63, pp. 309-

310). Holzman (37) has suggested that for material to be learned effectively it must be more vivid for Levelers than for Sharpeners. The high accuracy achieved by all subjects on the rectangle judging suggests that the correct judgments were "vivid" and easy even for Levelers, so that this factor caused them minimal difficulty.

5) Although a decrement in performance after interpolation would have been consistent with Postman and Page, even differential improvement for Levelers and Sharpeners would have lent some support to the general prediction of differences in response to interference, once the effect of initial level was ruled out. The fact that such differential improvement failed to occur, however, still does not justify a firm rejection of the hypothesis. The reason for this is the finding of substantial negative correlations between initial level of accuracy and extent of improvement in accuracy. It appeared that many of the subjects were prevented from improving by a "ceiling effect"--the level of accuracy was so high that it would be virtually impossible to improve. This difficulty might have been partially compensated for by the application of an analysis of covariance, but statistical considerations unfortunately precluded its use.

6) The argument that the expected differential improvements did not occur because of the "ceiling effect" is partially weakened by the fact that, although improvement was significantly

correlated with initial level for the total group, Levelers did not show significantly greater improvement as a group than Sharpeners. It would have been possible for the Levelers to improve to the level of the Sharpeners on the post-interpolation series, but the fact that the significant differences between groups on the post-interpolation series remained indicates a certain stability of these differences, in spite of the opportunity to reach a common asymptote. What remains as a possibility, however, is that Sharpeners might have improved relatively more than Levelers if it had not been for the "ceiling." So although the level of difficulty of the task as a whole limits the definiteness of the conclusions, the fact that Levelers improved no more than Sharpeners suggests that the self-limiting effects of Leveling were to some extent operative even at this generally easy level.

Manifest anxiety. The hypothesis that low anxiety subjects would show greater resistance to interference than high anxiety subjects was not confirmed, in that there was no significant interaction between anxiety groups and pre- and post-interpolation conditions. Postman and Page had indicated that the precision and consistency of judgments in their task had been reduced by "incompatible tendencies to respond to more than one dimension of variation" (94, pp. 375-376).

The experimental situation might have been expected to produce maximal interference at the beginning of the post-interpola-

tion series, so that highly anxious subjects would show the greatest impairment at this point. As the "correct" response (in this case, a response set) became dominant, the highly anxious subjects might actually surpass the low anxious, according to Spence-Taylor-Farber theory (108). Analysis of the "retroaction" and "learning" scores indicated that this did not occur. Anxiety groups showed no differential improvement within a single series, between parts of both series, or across both series taken as wholes (this last already established in the main analysis).

The difficulty level of the Rectangles Test can once more be considered at least partially responsible for the negative findings. Not only was the task apparently so easy as to practically eliminate any significant response competition, but it was also probably largely responsible for the fact that no significant improvement, or learning, occurred either within or across series. The level of accuracy seemed to have reached an asymptote on the first trial or two, and remained unchanged after this. The fact that different levels of drive failed to affect performance at this high level of learning is consistent with Ramond's finding that level of motivation has effect only at an intermediate level of learning (95a).

Joint effects of Leveling-Sharpening and manifest anxiety. The hypothesis that resistance to interference would be a joint function of Leveling-Sharpening and manifest anxiety was not con-

firmed, since the difference between pre- and post-tests, and selected parts of these, showed no significant relationship to either of the variables taken singly or together. Although the negative findings may have been due to the low difficulty level of the task, which may have been responsible for the lack of significant learning and interference in the rectangle judging situation, it should be noted once again in this connection that learning was not objectively impossible, especially for Levelers: their overall accuracy level of 83 per cent could have been improved upon. It must be concluded at this point that even an accuracy level of 83 per cent is too high to elicit interference and its interaction with the present variables.

Since improvement was objectively possible, its absence can be attributed at least partially to self-limiting features of the cognitive control and anxiety groups. The differences between groups remained very stable over both pre- and post-interpolation series; there was no significant tendency for groups to converge, diverge, or otherwise interact as the task, including the interpolated series, progressed. The trends showed no change over nearly 300 stimuli presented during a 45-minute period. It would have been interesting to test the stability of the Leveling asymptote at least, by continuing the test for a longer period; it is speculated that an extended period would have been required to produce any change.

Level of Difficulty

Level of difficulty was expected to be related to the operation of both independent variables, on the basis of their respective theories and empirical findings. The definition of Levelers and the method of their selection emphasized their particular difficulty on the embedded, or more difficult, square positions on the Schematizing Test (39, 53, 60, 63). The influence of difficulty level in accentuating differences between anxious and nonanxious subjects has also been demonstrated (25, 98), though negative evidence has appeared as well (11, 108, 116). On the basis of the existing evidence it was hypothesized that the differences between groups would be greater for the more difficult parts of the Rectangles Test.

While the analysis of variance treatment of the data indicated that hypotheses concerning the influence of difficulty level had to be rejected, an examination of the graph of the mean judgment scores of the groups (Figure 3) suggested <u>some</u> influence of difficulty level, and prompted separate analyses for difficult and easy parts of the task. Results indicated that Levelers differed from Sharpeners at a higher level of significance on the easy part, whereas the differences between anxiety groups existed only on the difficult part. Leveler and Sharpener subgroups within anxiety levels differed only on the easy stimuli, while

anxiety subgroups within Leveler and Sharpener groups differed only on the difficult ones (Table XVI).

There is suggestive evidence then that within the range of difficulty assessed, Leveling-Sharpening differences tended to be negatively related to difficulty level. The range of accuracy was from about 50 per cent correct on the difficult parts to about 90 per cent on the easy parts. In the present task, manifest anxiety was operative mainly within a 40 per cent to 60 per cent range of accuracy.

It can be speculated on the basis of these findings that Leveling-Sharpening cognitive controls and manifest anxiety apply to somewhat different spheres of behavior. The controls are most pronounced in the easy, "conflict free" parts of the test, and account for a large amount of individual differences; in the difficult, more challenging parts of the test, control differences are less, and anxiety differences are pronounced. It is possible that the disruptive properties of anxiety take precedence over the coping modes when sufficient difficulty (stress?) confronts the organism.

Difficulty level is not a sufficient explanation for the differential operation of the cognitive controls and manifest anxiety, however. The difficult parts of the Schematizing Test were at about the same level as the difficult parts of the Rectangles Test (around 50 per cent), yet in the former case control

differences were accentuated and anxiety effects absent. The appearance of anxiety effects and the slightly decreased influence of Leveling-Sharpening on the difficult part of the Rectangles Test must in part be associated with other variables in the rectangle judging situation as noted previously: rapid pacing of stimuli, examination tension, discomfort, ego-involvement, or still other unknown factors.

It may be speculated that if an even greater level of difficulty had been incorporated into the design, significant interactions of difficulty with both independent variables would have appeared in the main analysis. The anxiety variable might have shown stronger effects and the Leveling-Sharpening differences may have disappeared completely. The two variables overlap at intermediate levels of difficulty, but nearer the extremes there seems to be a tendency for only one to function.

By interpreting difficulty level as a "task stress" variable, support is found for Klein's latest formulation concerning cognitive attitudes (55). Klein points out that cognitive attitudes are different from "defenses" in the psychiatric usage, in that they do not stem from conflict but rather appear where quite "neutral" stimuli are involved. "We might even call them 'conflict-free' styles of regulation" (55, p. 269). Further, cognitive attitudes do not necessarily eliminate or reduce tension (45), though this is supposedly the main purpose of defense mech-

anisms.

The present study suggests that the cognitive controls of Leveling and Sharpening are most influential where the task is very easy, or, according to the current tentative interpretation, where "task stress" is minimal. In keeping with Klein's formulation, when "task stress" is increased and some degree of tension or conflict is aroused, defenses, rather than cognitive styles, are apt to come into play. In the present experiment, specific defenses were not assessed, but rather the potentiality for disturbance, as measured by the MAS. Under high task stress it was the degree of anxiety disturbance which separated groups more than did the cognitive controls. It was almost as though the anxiety response differences were replacing the preferred styles where difficulty increased. However, since these cognitive controls were not disrupted by anxiety on similar difficulty levels in the Schematizing Test, additional factors present in the rectangle judging must be considered as significant.

Directions for Future Study

This study has offered support for the concept of cognitive control by demonstrating the utility of one such control, Leveling-Sharpening, in predicting behavior in a visual size judgment task. The stability of this coping mode over a period of time

has been demonstrated, and its nature and applicability has been further specified. Leveling and Sharpening were found to be unrelated to shifting in reference level or to tendencies toward overestimation or underestimation. Further evidence was also found for the disruptive effects of manifest anxiety in perception, but these effects were confined to the more difficult parts of the visual size judgment task. Leveling-Sharpening and manifest anxiety were unrelated, but since both influenced the ranking accuracy in visual size judgment, the use of the two variables in combination increased the precision of prediction. The present experiment therefore supports the recommendations by many prominent psychological investigators to the effect that control factors should be included in experimental designs (55, 60, 69, 70, 126). In fact, as the analysis of the present experiment proceeded, the need to recognize an increasing number of significant variables was felt, and increasingly complex designs would seem to be necessary for future experimentation.

Prominent among the other significant variables in the present study was level of difficulty. Anxiety effects were significant only on the more difficult parts of the task, while cognitive control effects were more outstanding on the easy parts. One direction for future study would be to investigate the influence of difficulty level in much more detail by setting up a wide range of difficulty with several intervening levels. If

the trends found in the present study were extended, a level of difficulty might be obtained which would be sufficiently high to obliterate differences between Levelers and Sharpeners completely. The findings could then be further generalized by investigating wide difficulty ranges in new tasks.

Since the hypothesis concerning differences between Levelers and Sharpeners was not adequately tested in the present experiment, this should be investigated further. A testing situation more similar to that of Postman and Page and conventional retroaction paradigms could be devised. Care should be taken to demonstrate learning in each part of the task, and interference effects should be established by the use of appropriate control groups. It is predicted that Levelers would show greater interference effects in such a situation, and since anxiety has already been related to this type of situation, it could also be introduced, and the effects of both variables studied jointly. From here investigation could be extended to more conventional verbal retroaction paradigms and then to various other aspects of the field of learning. Extensions into the areas of personality and group behavior could also be devised, as envisioned by Klein (53, 60).

Other Unsolved Issues

1) Whether or not cognitive controls are related to the type and strength of psychiatric defenses in any orderly manner is unknown. Klein has made a strong, if not altogether successful, attempt to distinguish the two (55). In a more recent article, Holzman and Klein (45) reported an expected relationship between a cognitive control and a psychological defense mechanism, though they observedthat the correlation was far from perfect. The present study offers no evidence on this issue, in that no specific defense was incorporated into the design, but rather a nonspecific, diffuse reaction (anxiety), giving no particular indication as to what mechanism might be invoked to handle the anxiety.

2) Another point which has not been touched upon in the present experiment is the problem of the organismic origin and locus of major influence of the two independent variables. Klein has speculated that cognitive controls are primary central (cortical) regulating principles, and that the effects of needs, drives, and other such factors are "secondary" (55). These controls guide "the way in which neural correlates of all sense-data, brain traces, distribute themselves" (39, p. 391).

Anxiety, on the other hand, conceivably may exert its influence at the sensory, cortical, or motor levels. The Hullian theorists have treated anxiety in terms of response and the intervening variable, excitatory potential. Meyer (86, 87) has discussed anxiety as affecting efferent neural interaction. Discrimination studies at Duke (30, 65, 66, 121) seem to emphasize the possible sensory locus of the effects of anxiety, but cortical or motor involvement has not been ruled out. More recently, the Menninger group has suggested that controls are operative both at the perceptual and action levels (45, p. 189). For the time being, the point or points within the organism at which cognitive controls and anxiety variables exert their influence remains an open question.

3) Still another unsolved issue is the degree to which cognitive controls are "primary," in Klein's use of the term. Although Wallach (123) has suggested that motives can affect cognitive organization only after the initial perceptual process-formation, Klein has maintained that "regulative styles of personality organization are reflected in the individual differences that appear on the level of process formation itself" (55, p. 229). The extent to which these differences may be attributed to innate factors and to learning remains to be explored. Developmental studies could help to determine the factors influencing the formation of cognitive controls, their degree of "in-

nateness," and the extent to which different laws apply to these "primary" controls in contrast to "secondary" defenses.

4) Finally, the range of applicability of cognitive control principles requires much further study. Holzman extended his findings of Leveling-Sharpening differences in visual time-error into the auditory and kinesthetic realms (39). Krathwohl and Cronbach concluded that Leveling-Sharpening principles could not yet be interpreted in terms of personality and ability constructs (63). Holzman conservatively observed that "all you can expect to predict from a knowledge of whether a person is a leveler or a sharpener is what he will do in another experiment that requires him to make fine distinctions among stimuli" (41). The present experiment extended the applicability of this concept to a rather limited degree. However, the Menninger group had originally postulated that the cognitive control principles could eventually be expanded to describe personality (53, 60), and Klein reported some success in correlating Leveling-Sharpening controls to personality attributes (53). Subsequent studies have been less supportive, but the methodology of most of these studies makes it difficult to evaluate the results. If a comprehensive and unified system of principles and terms for all behavior is to emerge from the perception-centered approach, a more rigorous methodology for the derivation of variables will have to be de-

veloped and applied; then the generality of the principles can be tested in other "areas" of behavior.

Chapter V

SUMMARY AND CONCLUSIONS

Background of the Problem

Various psychological investigators have pointed out the need for incorporating a class of variables termed "cognitive controls" in studies of motivation, perception, and personality. Cognitive controls are sets or dispositions which determine the pattern or style of an individual's response to problems requiring adaptation. One cognitive control dimension that has been studied is called Leveling-Sharpening. Leveling is the characteristic tendency to diminish or overlook stimulus differences while Sharpening is the tendency to accentuate such differences. Levelers should show poorer accuracy in visual size judgment and greater retroactive inhibition due to their difficulty in keeping stimulus traces distinct.

Anxiety has been found to impair sensory discrimination, to interfere with the shifting of sets, and to increase negative transfer. High anxiety subjects should also show poorer accuracy in visual size judgment, and greater retroactive inhibition due to the intensification of competing response tendencies. Increased level of difficulty should accentuate differences between groups. The present experiment was designed to investigate the relevance of the cognitive controls of Leveling and Sharpening to a study of the effects of anxiety in a visual size judgment task with a condition designed to elicit retroactive inhibition. In so doing, the importance of including cognitive control variables in the design of experiments in motivation and perception could be demonstrated.

Hypotheses

The major hypotheses were: 1) Sharpeners will show greater accuracy in visual size judgment than Levelers; low anxiety subjects will show greater accuracy than high anxiety subjects; these effects will summate so that low anxiety Sharpeners will have the highest accuracy, high anxiety Levelers will have the lowest accuracy, and groups with other combinations of anxiety and control will be intermediate in accuracy. 2) Sharpeners and low anxiety subjects will show the greatest resistance to

interference in the visual size judgment task; summation of effects and similar ranking are predicted as for accuracy. 3) Increased level of difficulty will lead to an accentuation of differences between groups, in both level of accuracy and susceptibility to interference.

Subjects and Procedure

Forty-eight subjects were selected according to the conventional methods for obtaining Levelers and Sharpeners, and according to the conventional categories of the Taylor Manifest Anxiety Scale. The final groups consisted of 14 high anxiety Levelers, 10 low anxiety Levelers, 14 high anxiety Sharpeners, 10 low anxiety Sharpeners. These subjects were tested in a visual size judgment task similar to that used by Postman and Page to demonstrate retroactive inhibition in psychophysical judgment. The subjects first judged a series of thirteen comparison rectangles as wider or narrower than a standard rectangle; they then judged the same rectangles as taller or shorter than the standard; and they then made a final series of judgments of width. The records of each subject were scored in terms of PSE, SD, and a "number correct" score which ignored the extent of the deviation of the comparison rectangle from the standard.

Results

The hypotheses that Levelers would show poorer accuracy than Sharpeners, and that high anxiety subjects would show poorer accuracy than low anxiety subjects, were supported by significant differences in SD and "number correct" scores. There were no differences in PSE. Scores on the first series of judgments of width did not differ from those on the final series of judgments of width, and there were no interactions of groups with these conditions. Since a significant amount of learning could not be demonstrated either within or between series, it was concluded that learning interpretations could not be applied, and that hypotheses concerning retroactive inhibition or interference had not been adequately tested.

When responses were broken down according to easy and difficult parts of the rectangle judging task, and individual group means were compared for significance, differences between Levelers and Sharpeners were greater on the easier parts of the task, while differences between high and low anxiety groups were significant only on the more difficult parts.

Conclusions

1) Leveling and Sharpening are stable cognitive controls which account for a significant amount of the individual differences in accuracy in a visual size judgment task. Sharpeners show greater accuracy as predicted.

2) High manifest anxiety is associated with poorer accuracy of visual size judgment.

3) Leveling-Sharpening cognitive controls and manifest anxiety are independent factors, the effects of which summate in accuracy of visual size judgment. Accurate prediction of level of accuracy requires that both control and anxiety variables be taken into consideration.

4) There are no differences between groups in their response to interference. The failure to demonstrate interference effects is attributed mainly to the low level of difficulty of the task and the subsequent lack of learning.

5) Level of difficulty is an important variable in predicting the effects of Leveling-Sharpening and manifest anxiety on accuracy of visual size judgment. Leveler-Sharpener differences are most prominent on the easy, "conflict free" parts of the task, while differences between anxiety groups appear only on difficult parts of the task.

APPENDICES

Appendix I

LEVELING-SHARPENING AND MANIFEST ANXIETY: THE PRELIMINARY STUDY

Hypotheses of the Preliminary Study

The preliminary study was undertaken to investigate the possibility that manifest anxiety and Leveling-Sharpening might actually be reflections of a single underlying process. In spite of their claim to conceptual distinctness as drive on one hand, and control on the other, it was speculated that both these variables might at least in large part be a function of a "general factor of discrimination" (119). Since impaired discrimination was found among highly anxious subjects in previous studies at Duke (30, 65) and elsewhere, the first hypothesis raised was that the relatively poor discrimination shown by Levelers might be associated with high anxiety.

In commenting on this hypothesis, Holzman (38) reiterated that Leveling and Sharpening were "preferred modes" of dealing with sicuations, and accordingly were unlikely to be related to anxiety in any systematic way. He did point out, however, that a low score on the Schematizing Test, which would appear to in-

dicate "leveling," could also result from distractability such as found in anxiety states, or from indifference. In other words, optimal motivational conditions, where drive is neither too weak nor too intense, would produce the most effective (Sharpening) behavior.

Subsequently a number of alternative hypotheses were raised in addition to the originally proposed one. A second possibility was that Levelers might be both the poorly motivated and the overanxious (extreme high and low scorers on the Taylor Scale), with Sharpeners tending to fall in the intermediate range of anxiety. This would be in accord with Matarazzo's (78) curvillinear hypothesis concerning the relation of efficiency to MAS. A third alternative was considered: if Leveling and Sharpening are both characteristic "conflict free" response modes which effectively bind anxiety, then Levelers and Sharpeners would have the lowest MAS scores, and those subjects scoring in the intermediate range on the Schematizing Test, who had not adopted any consistent response mode, might be the more anxious.

On the basis of Hullian drive theory, it can be predicted that high drive will improve performance (probability of the correct response) where single dominant response tendencies are aroused, and impair performance where a number of competing responses are present. On the basis of previous studies with the

Schematizing Test it was known that the extreme squares in a series (the smallest or largest) were easily discriminated, whereas the embedded squares of intermediate size were much more difficult. Applying drive theory to the Schematizing Test, it was hypothesized that high anxiety subjects would show greater decrement on the difficult squares than the low anxiety subjects. This would be tested in an analysis of variance by the interaction term between square position and anxiety groups.

Intelligence was also incorporated in the preliminary study as a potentially relevant variable. It was speculated that the more perceptive, effective Sharpeners might have higher intelligence scores. Schematizing behavior might be in part a function of anxiety or intelligence, or a function of their summation or interaction.

Method of the Preliminary Study

A group of 55 volunteer subjects (41 males, 14 females) from an introductory course in psychology were run on the Schematizing Test under conditions very similar to those described by Holzman (37). Levelers ($\underline{N}$=12) and Sharpeners ($\underline{N}$=12) were selected according to the conventional criteria, and their plotted scores were in close correspondence with those obtained in the two prior

studies by the Menninger group (39, 43). Scores on the Taylor Scale of Manifest Anxiety were available for all subjects, and ACE scores were obtained from the admissions files on 48 of the subjects.

Results of the Preliminary Study

In order to test the first and third hypotheses (that Levelers, or the intermediate group, might have the higher MAS scores), a simple analysis of the variance of anxiety scores was made, using Levelers, Sharpeners, and three intermediate groups as treatments. No significant MAS differences were found between groups. A nonparametric test was also planned as a check on these findings. The number of Levelers and Sharpeners falling above and below the median of anxiety scores was tallied. For the Sharpeners, 6 fell above the median score on the anxiety scale, and 6 below; for the Levelers, 7 were above and 5 below, an obviously insignificant difference. In order to test the second hypothesis (that Levelers might tend to be poorly or overmotivated), the number of extreme high and low anxiety scores were tallied for Levelers and Sharpeners. In terms of the conventional cut-off points for extreme groups on the MAS (1-7; 21 and above), two Levelers and two Sharpeners fell in the high anxiety group, and one Leveler and four Sharpeners fell in the low

anxiety group. These numbers were considered too small to warrant a formal statistical test, but tended to argue against the second hypothesis.

The drive theory hypothesis concerning the interaction between anxiety and difficulty level was tested in a 5 X 3 (square position and levels of anxiety) analysis of variance, with accuracy as the dependent variable. The effect of square position was significant well beyond the .001 level, but the main effect of anxiety failed to reach significance at the .05 level, and there was no interaction between anxiety and square position.

Intelligence (ACE) differences were tested by a simple analysis of variance, the treatment groups being Levelers, Sharpeners, and three middle groups. There were no significant differences between groups in ACE Total, Linguistic, or Quantitative scores.

As a further check, correlations were computed between MAS and ACE, and various Schematizing measures. ACE and MAS correlated -.23 which fails to reach significance at the .05 level. Individual, partial, and multiple correlations were computed between MAS and ACE, and three measures of accuracy and three measures of intrasubject variability in Schematizing. None reached significance at the .05 level. (More detailed results will be reported in [90].) Sex differences were not striking, but the numbers were too small to suggest definite conclusions.

Conclusions from the Preliminary Study

The possibility of obtaining a Leveling-Sharpening dimension comparable to those found in previous studies, despite possible differences in student populations between Duke and Kansas, was confirmed. Leveling-Sharpening appeared to be free of any contaminating effects of manifest anxiety, intelligence, or sex, lending support to its status as an independent dimension of behavior. In future studies the selection of subjects or interpretation of results on the basis of one or more of these variables should not be biased by the subjects' scores on the others.

The lack of relationship between intelligence (ACE) and Leveling-Sharpening has been confirmed by Holzman (41), Krathwohl and Cronbach (63), Siegal (102), and in an unpublished study by the present author and Louis D. Cohen.

Appendix II

THE TAYLOR MANIFEST ANXIETY SCALE

Table XVIII

Scores on the Taylor Manifest Anxiety Scale for Two Semesters of Students in Introductory Psychology[a]

	Male			Female			Total	
	N	Mean	SD	N	Mean	SD	N	Mean
Fall 1956	160	14.8	7.0	119	15.4	8.2	279	15.1
Spring 1957	101	15.5	7.2	38	14.4	6.2	139	15.2
Total	261	15.1	---	157	15.2	---	418	15.1

[a]Data furnished by Spielberger (112). The table includes only those subjects for whom ACE scores were also available; a slightly larger number of subjects formed the pool for the present investigation.

BIOGRAPHICAL INVENTORY - Form TAL

INSTRUCTIONS: For each of the following statements decide whether it is True as applied to you, or False as applied to you. If it is True or mostly true, circle T on your answer sheet; if it is False or not usually true, circle F. If you cannot decide circle the number of the question on your answer sheet.

1. I do not tire quickly.
2. I am often sick to my stomach.
3. I am about as nervous as other people.
4. I have very few headaches.
5. I work under a great deal of strain.
6. Once in a while I think of things too bad to talk about.
7. I cannot keep my mind on one thing.
8. I worry over money and business.
9. I frequently notice my hand shakes when I try to do something.
10. I blush as often as others.
11. I do not always tell the truth.
12. I have diarrhea ("the runs") once a month or more.
13. I worry quite a bit over possible troubles.
14. I practically never blush.
15. I get angry sometimes.
16. I am not often afraid that I am going to blush.
17. I have nightmares every few nights.
18. My hands and feet are usually warm enough.

19. I sweat very easily even on cool days.

20. When embarrassed I often break out in a sweat which is very annoying.

21. Sometimes when I am not feeling well I am cross.

22. I do not often notice my heart pounding and I am seldom short of breath.

23. I feel hungry almost all the time.

24. If I could get into a movie without paying and be sure I was not seen, I would probably do it.

25. Often my bowels don't move for several days at a time.

26. I have a great deal of stomach trouble.

27. I would rather win than lose in a game.

28. At times I lose sleep over worry.

29. My sleep is restless and disturbed.

30. I often dream about things I don't like to tell other people.

31. I like to know some important people because it makes me feel important.

32. I am easily embarrassed.

33. My feelings are hurt easier than most people.

34. I often find myself worrying about something.

35. I do not like everyone I know.

36. I wish I could be as happy as others.

37. I am usually calm and not easily upset.

38. I gossip a little at times.

39. I cry easily.

40. I feel anxious about something or someone almost all the time.

41. I am happy most of the time.

42. It makes me nervous to have to wait.

43. Sometimes at elections I vote for men about whom I know very little.

44. At times I am so restless that I cannot sit in a chair for very long.

45. Sometimes I get so excited that I find it hard to get to sleep.

46. I have often felt that I faced so many difficulties I could not overcome them.

47. Once in a while I laugh at a dirty joke.

48. At times I have been worried beyond reason about something that really did not matter.

49. I do not have as many fears as my friends.

50. I have been afraid of things or people that I know could not hurt me.

51. At times I feel like swearing.

52. I certainly feel useless at times.

53. I find it hard to keep my mind on a task or job.

54. I am more self-conscious than most people.

55. I do not read every editorial in the newspaper every day.

56. I am the kind of person who takes things hard.

57. I am a very nervous person.

58. Life is often a strain for me.

59. At times I think I am no good at all.

60. Once in a while I put off until tomorrow what I should do today.

61. I am not at all confident of myself.

62. At times I feel that I am going to crack up.

63. I don't like to face a difficulty or make an important decision.

64. My table manners are not quite as good at home as when I am out in company.

65. I am very confident of myself.

Appendix III

THE SCHEMATIZING TEST

Conditions and Apparatus

Conditions for the Schematizing Test closely followed those established by the Menninger group (37, 40). Groups varying in size from 3 to 10 were seated in two rows directly in front of the projection apparatus which was 16 1/2 feet from the screen. The tests were conducted at night, and the room was in total darkness except for the small lights used by the subjects for recording. The screen was a large heavy black cloth, 8 1/2 feet by 8 1/2 feet, which hung from the ceiling almost to the floor, and blended completely with its background in the very low illumination.

White squares were exposed on the screen by means of a TDC Vivid slide projector, model D, powered by standard 300 watt lamp. The original filmstrip[1] was converted into standard 2x2

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1. Our thanks to Dr. Ben Willerman who furnished the filmstrip.

inch glass slides in order to protect the film from scratches. The projector was encased in a box containing a blade shutter which was opened by a 110 volt A. C. solenoid with a 1 1/2 inch thrust. The solenoid was activated by a microswitch which was tripped by the cams of a 1/4 inch lucite circular disc attached to a one r. p. m. synchronous motor.[2] The shutter was open for 3 seconds and off for 9 seconds,[3] permitting five complete exposures a minute. The slides were moved by a manual changer operated during the "off" period.

Subjects were provided with a three-page booklet numbered from 1 to 150. They were requested to write their judgments opposite the number of the square which had been exposed. Each subject had a small one-cell flashlight which he held in his nonpreferred hand and turned on long enough to record his judgment. Two-minute rest periods were given after squares 50 and

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2. Our thanks also to Dr. Norman Guttman who designed the apparatus, and to Mr. George Carver who constructed it and made various alterations and repairs during more than two years of experimentation.

3. Holzman used an 8 second "off" interval. The 9-second interval used here was required by the nature of the mechanical timer. It was assumed that this would have no great effect on the results, and subsequent comparison of our data with Holzman's confirmed this assumption.

100, the room remaining in darkness. Smoking was not permitted.

The entire experiment required about 40-45 minutes, including instructions, and the handling of questions directly after the instructions. The only question encountered with any frequency concerned the units to be used in recording the sizes of the squares. Following Holzman's recommendation, the experimenter replied, "That's up to you. However you wish to do it."

Instructions

The instructions were exposed on the screen long enough for the experimenter to read them twice silently. Since these instructions are not readily accessible, they are repeated here. After announcing, "We are now ready to begin," the experimenter showed the following:

We wish to see how well you can judge the size of squares. We're going to show you a number of squares on the screen and we want you to tell us how big they are.

The squares may range anywhere between 1 inch and 18 inches. This doesn't mean you will necessarily get a square which is 1 inch or 18 inches, though you may. The squares will always be somewhere within this range.

To help you judge the size of the squares, we will show you what a 1-inch square looks like--the smaller end of the range--and what an 18-inch square looks like--the larger end of the range.

The 1-inch square and the 18-inch square are exposed now for about 5 seconds each.

We will show them to you again.

You will see 150 squares during the course of the hour and you have 150 numbered spaces on your sheet. Write your estimation of the size of each square in its own numbered space. Thus for Square No. 1 record its size in inches next to No. 1, etc.

Don't go back over your judgments to change them. In changing them you are more likely to be inaccurate. Please don't compare your estimates with anyone or make any comment during the hour. Make your judgments independently.

Now to remind you once again of the range in which the squares will fall, we will show you again the smaller and the larger ends of the range.

The 1-inch and 18-inch squares are then exposed twice allowing 5 seconds for each exposure.

Now we are ready to begin. You will see each of the following squares for only a few seconds. Look at it all the time it is on the screen and make your estimation when it disappears. The next square you see will be No. 1.

The Stimulus Series

The presentation of the 150 stimuli was as follows: at first the five smallest squares are shown in ascending order, then twice again in a mixed-up order. On the next series, the smallest square is dropped out and the next largest is inserted. In this way the mean size of the series gradually increases until the entire range of 150 squares is traversed. (The actual order of

presentation may be found at the end of this section.)

Scoring

The selection of Levelers and Sharpeners is based upon a combination of two scores: 1) within-series ordinal (ranking) accuracy, and 2) loss of ordinal accuracy as a function of salience of square position.

1) Within-series ranking accuracy (Acc). In order to eliminate differences in absolute scale units or range used by different subjects, only the relative position in a series of five is scored. In other words, how often does the subject see the largest square as the largest, the second largest as the second largest, and so on. The Acc score is the sum of the number of correct rankings.

2) Loss of ranking accuracy (A.L.). It has been demonstrated that the largest square in the series is almost invariably judged correctly more often than the squares in the other four positions, especially the intermediate or "embedded" ones. The second element in distinguishing Levelers and Sharpeners, besides their overall

> ranking accuracy (Acc), is the amount of loss or decrement occurring in the judging of the more difficult embedded squares in comparison with the easiest one. A measure of this is obtained by subtracting the score (number correct) on each of the first (smallest), second, third, and fourth square positions from the score on the fifth (largest) square position. The sum of these discrepancies is the Loss of Accuracy (A.L.) score.

A critique of the rationale of these scores has been made by Krathwohl and Cronbach (60). The two have been found to correlate -.70 and -.58 in two previous studies at Duke (90), and although highly related, are sufficiently different to warrant the continued use of both.

The Schematizing scores of the total group sampled in the present study is compared with a number of other studies in Table XIX.

Table XIX shows a high similarity in the median and mean scores of both accuracy and loss of accuracy in the two Duke studies. The mean accuracy score also compares closely with that reported by Siegal for the two groups used in his recent dissertation (102). The standard deviations of the accuracy scores

Table XIX

Schematizing Scores of the Total Sample used in the Present Study Compared with Previous Studies

		Accuracy			Loss of Accuracy		
	N	Mdn	Mean	SD	Mdn	Mean	SD
Present Study	148	101.5	97.0	26.2	28.0	27.9	12.8
Prelim. Study (90)	55	103.0	100.0	16.8	28.0	28.6	12.3
Siegal 1 (102)	50	-----	103.4	19.4	----	----	----
Siegal 2 (102)	25	-----	103.6	23.2	----	----	----
Krathwohl and Cronbach (63)	32?	-----	-----	14.7	----	----	2.1

vary considerably however; the largest is over one and one-half times as the smallest. In the present study there were a few individuals with very low scores, and these scores were mainly responsible for a negative skewness in the distribution and the increased standard deviation. There was no reason to exclude these individuals however. The strikingly deviant statistics reported by Krathwohl and Cronbach cannot readily be explained, but because of the small number of subjects involved, a biased sample may have been obtained.

In order that results of the present study would be comparable to those of previous studies, only subjects manifesting extreme Leveling and Sharpening behavior were used. These groups were arrived at in the following manner. Two distributions were drawn up: subjects were ranked according to Acc score, and according to A. L. score. Each distribution was divided at the median. The median Acc score was 101.5 (67.7 per cent), and for A. L. the median was 28 (18.7 per cent), comparing closely with the findings of Holzman (40) and our own previous studies (90). Following Holzman's procedure, Sharpeners are operationally defined as those who score above the median on Acc and below the median on A. L., that is, they show high overall accuracy and little loss of accuracy on more difficult squares. Levelers are those who score below the median on Acc and above the median on Acc and above the median on A. L., that is, they have low overall accuracy and show considerable loss on more difficult squares. Those who showed low accuracy and little loss, or high overall accuracy and marked loss were eliminated because they did not fit the criteria for consistent Leveling and Sharpening. In this way 32 subjects were eliminated, leaving 116 consistent subjects, half Levelers and half Sharpeners.

In order to obtain extreme groups of Levelers and Sharpeners, the two dimensions were combined by transforming each score to a standard score ($z = x/s$, where s is the standard deviation

of the distribution of scores) and combining scores for individuals. This standard score, called by Krathwohl and Cronbach[4] the L. S. score is obtained by the formula:

$$L.S. = \frac{Acc}{s\ Acc} - \frac{A.L.}{s\ A.L.}$$

Using 27 per cent as the conventional cut-off point for fixing the extremes of a distribution (49), Sharpeners were those who fell in the upper 27 per cent of the L. S. distribution, and Levelers were those who fell in the bottom 27 per cent. This method left 29 Sharpeners and 30 Levelers. The close similarity between the scores of our groups and those of Holzman and Klein (43) is shown in Figures 4 and 5. Since the necessary data are not furnished by Holzman and Klein, formal statistical tests of the differences in groups have not been possible; however, if the variances of their groups are estimated as similar to the Duke groups, the differences are clearly nonsignificant.

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4. Krathwohl and Cronbach, apparently misled by Holzman's inexact statement that "we called those subjects sharpeners who fell in the upper half of both distributions and those people levelers who were in the lower half of both distributions" (37, p. 48), incorrectly report the sign in this formula as plus (63, p. 312). A careful consideration of the rationale will show why this is obviously incorrect.

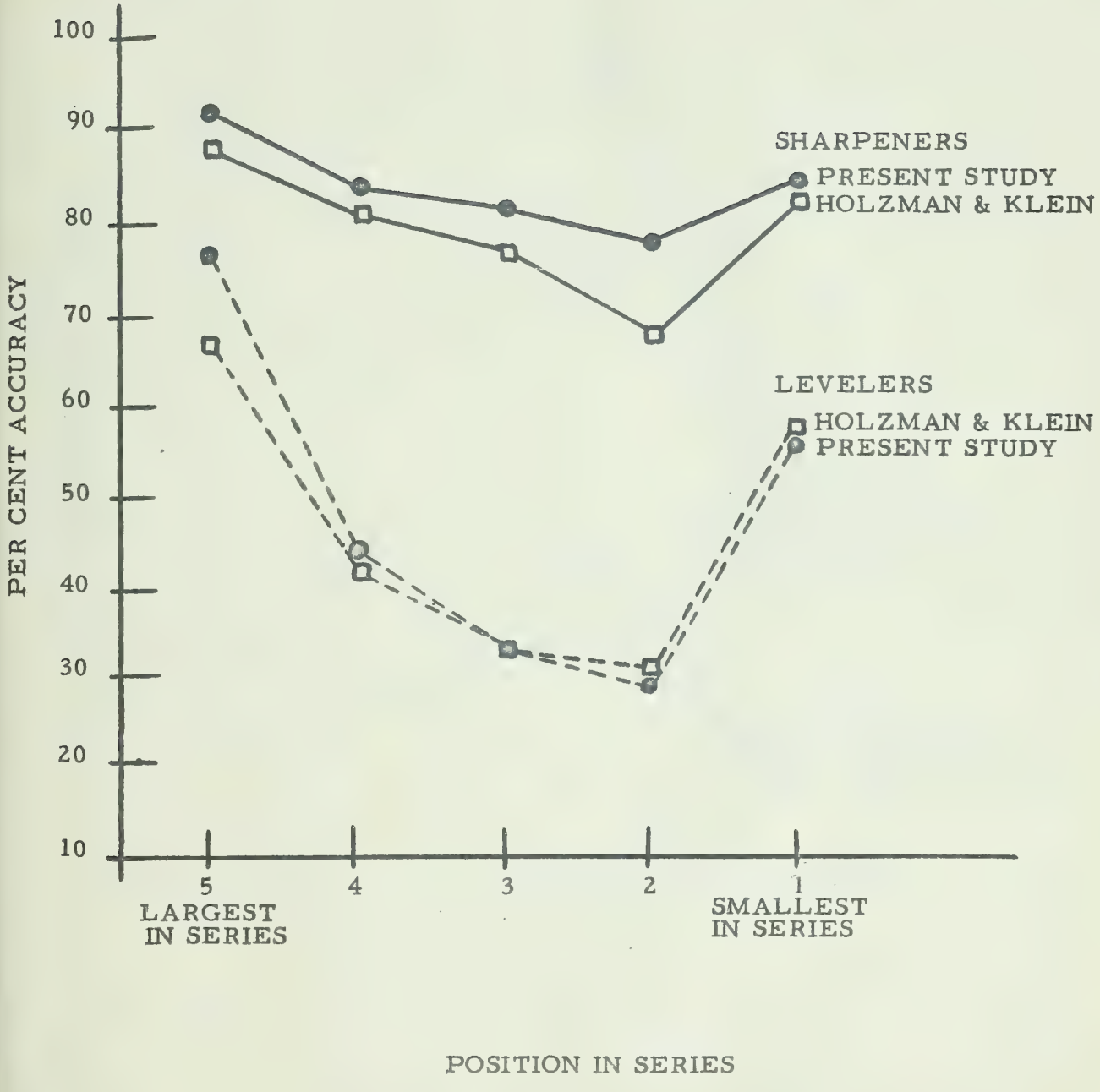

Fig. 4. Percentage of accurate rankings by Levelers and Sharpeners as a function of square position in series.

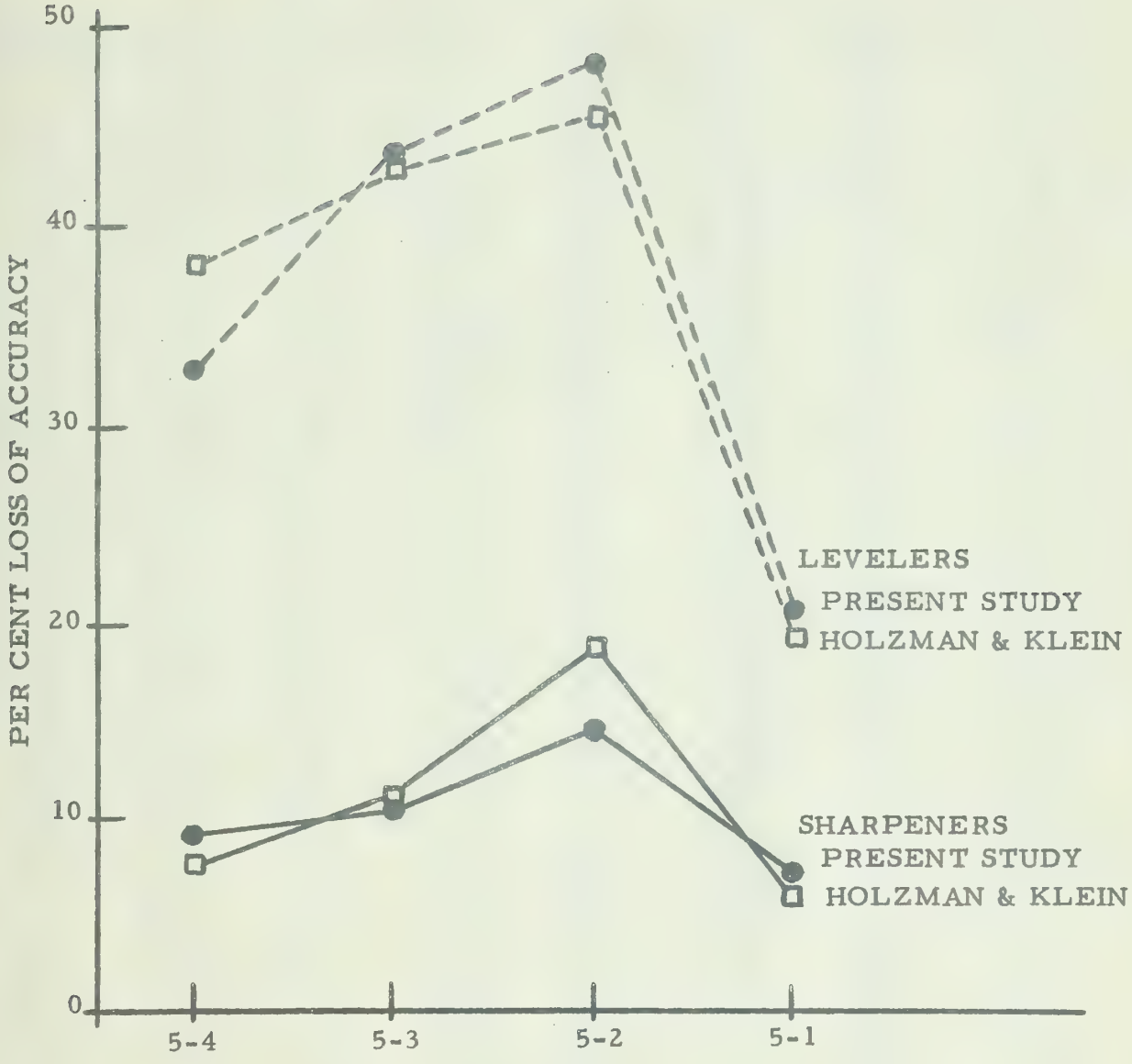

Fig. 5. Loss in percentage of accurate rankings by Levelers and Sharpeners as a function of square position in series.

Schematizing Test
Order of Presentation of Squares

Order	Size	Order	Size	Order	Size	Order	Size
1.	1.18"	39.	1.97"	77.	3.83"	115.	7.95"
2.	1.57	40.	3.19	78.	4.59	116.	4.59
3.	1.97	41.	1.97	79.	5.52	117.	9.53
4.	2.36	42.	3.83	80.	6.62	118.	6.62
5.	2.83	43.	2.83	81.	4.59	119.	7.95
6.	1.97	44.	3.19	82.	3.83	120.	5.52
7.	1.57	45.	2.36	83.	6.62	121.	5.52
8.	2.83	46.	2.36	84.	3.19	122.	6.62
9.	1.18	47.	2.83	85.	5.52	123.	7.95
10.	2.36	48.	3.19	86.	3.19	124.	9.53
11.	1.18	49.	3.83	87.	6.62	125.	11.44
12.	2.83	50.	4.59	88.	4.59	126.	7.95
13.	1.97	51.	3.19	89.	5.52	127.	6.62
14.	2.36	52.	2.83	90.	3.83	128.	11.44
15.	1.57	53.	4.59	91.	3.83	129.	5.52
16.	1.57	54.	2.36	92.	4.59	130.	9.53
17.	1.97	55.	3.83	93.	5.52	131.	5.52
18.	2.36	56.	2.36	94.	6.62	132.	11.44
19.	2.83	57.	4.59	95.	7.95	133.	7.95
20.	3.19	58.	3.19	96.	5.52	134.	9.53
21.	2.36	59.	3.83	97.	4.59	135.	6.62
22.	1.97	60.	2.83	98.	7.95	136.	6.62
23.	3.19	61.	2.83	99.	3.83	137.	7.95
24.	1.57	62.	3.19	100.	6.62	138.	9.53
25.	2.83	63.	3.83	101.	3.83	139.	11.44
26.	1.57	64.	4.59	102.	7.95	140.	13.73
27.	3.19	65.	5.52	103.	5.52	141.	9.53
28.	2.36	66.	3.83	104.	6.62	142.	7.95
29.	2.83	67.	3.19	105.	4.59	143.	13.73
30.	1.97	68.	5.52	106.	4.59	144.	6.62
31.	1.97	69.	2.83	107.	5.52	145.	11.44
32.	2.36	70.	4.59	108.	6.62	146.	6.62
33.	2.83	71.	2.83	109.	7.95	147.	13.73
34.	3.19	72.	5.52	110.	9.53	148.	9.53
35.	3.83	73.	3.83	111.	6.62	149.	11.44
36.	2.83	74.	4.59	112.	5.52	150.	7.95
37.	2.36	75.	3.19	113.	9.53		
38.	3.83	76.	3.19	114.	4.59		

ANSWER SHEET (PERCEPTION)

NAME:_____ AGE:_____

ADDRESS

_____ DATE:_____

PHONE NO:_____

1	18	35
2	19	36
3	20	37
4	21	38
5	22	39
6	23	40
7	24	41
8	25	42
9	26	43
10	27	44
11	28	45
12	29	46
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14	31	48
15	32	49
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Appendix IV

THE RECTANGLES TEST

Test Conditions

Test conditions were nearly identical to those for the Schematizing Test: subjects were tested in the same dark room, in the same seats, and in groups of similar size. As before, they recorded their judgments on a numbered sheet (see copy following), illuminated by a small single cell flashlight. Two-minute rest periods were given between the three parts of the test. The time since taking the Schematizing Test varied from as much as five months for the first semester group to three months for the second semester group. As the room was not airconditioned, the temperature was noticeably higher during the Rectangles Test than it had been for the Schematizing Test. No other variations in conditions were noted.

Apparatus

The series of rectangles was presented in a similar manner to that employed in the Schematizing Test. The stimuli were projected from a filmstrip[5] by means of a filmstrip adapter attachment on a LaBelle Professional projector with standard lamp. The same mechanical shutter used for the Schematizing Test was used here with a difference in time interval. Each rectangle was exposed for .8 sec., with an interstimulus interval of 3.2 sec., permitting fifteen exposures per minute. The stimuli were changed manually during the dark interval.

Stimuli

The stimuli were a series of white rectangles exposed on the black screen. The standard rectangle was 6 7/16 inches wide by 4 13/16 inches high. There were thirteen comparison rectangles, twelve of which differed from the standard in both height and width. Increments and decrements in both height and width ranged from -1 2/16 inches to +1 2/16 inches, arranged symmetrically in

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5. The assistance of Mr. Sam Boone of the Photographic Laboratory of the University of North Carolina, who produced the filmstrip, is gratefully acknowledged.

3/16 inch steps with respect to the standard. Following Postman and Page, variations in height were originally paired at random with variations in width so that any change in one dimension had an equal chance of being associated with any change in the other dimension. This was done by a method of random selection, using the random permutations table provided by Cochran and Cox (10).

Preliminary testing indicated a marked effect of the interaction between height and width on judgment. If a rectangle was considerably wider than the standard, it tended to be judged shorter than it really was, for example. An increase in one dimension tended to lead to judgments of "smaller" in the other dimension. Thus an increase in the non-judged dimension facilitated a correct response when the other dimension being judged was in reality smaller than the standard; similarly an increase in the non-judged dimension tended to increase the difficulty of making a correct judgment when the other dimension was in reality greater than the standard (but tended to appear smaller, by reason of the interaction with the other dimension). The initial series contained a definite majority of "facilitating" rectangles.

This interaction effect was counterbalanced to some extent by pairing half of the increases in width with increases in height, and half with decreases in height. The same procedure was followed for the decreases in width. The stimulus series then involved the following relationships:

greater width with greater height	:	3	comparison rectangles
greater width with less height	:	3	" "
less width with greater height	:	3	" "
less width with less height	:	3	" "
same width with same height	:	1	" rectangle

Within these restrictions, pairing was random. For example, any 3 of the six degrees of greater width was paired with any 3 of the six degrees of greater height; the remaining 3 degrees of greater width were paired with any 3 of the six degrees of less height, and so on.

The final projected sizes of the variable stimuli used in this experiment were:

Rectangle No.	Size in Inches
1	5 5/16 x 5 15/16
2	5 8/16 x 3 11/16
3	5 11/16 x 4 10/16
4	5 14/16 x 5 6/16
5	6 1/16 x 5
6	6 4/16 x 3 14/16
7	6 7/16 x 4 13/16 (same size as standard)
8	6 10/16 x 5 9/16
9	6 13/16 x 4 1/16
10	7 x 4 7/16
11	7 3/16 x 5 12/16

Rectangle No.	Size in Inches
12	7 6/16 x 5 3/16
13	7 9/16 x 4 4/16

Following the Postman and Page method, the standard was exposed after every fifth variable. The experimental series comprised 91 judgments, with each of the thirteen comparison stimuli appearing seven times. The sequence within each series of thirteen was randomized separately for each series. The complete stimulus series used appears at the end of this section.[6]

Instructions[7]

The instructions for the first part of the experiment were

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6. Conditions did not permit the carrying out of a proper pilot study to determine whether the expected psychophysical functions would be obtained with this stimulus series. There were several delays in constructing the filmstrip, and when it was finally produced, testing had to begin almost immediately, or many of the subjects would have been lost through graduation. A pilot study involving a total of seven subjects was carried out, using a one-second exposure time. The results indicated that all subjects were quite accurate, so the exposure time was reduced to 0.8 sec. Further testing at this exposure time was not possible, as the first formal testing session had been scheduled for the following night. Due to the same time pressures, a replication of the Postman and Page study, using the present stimuli and similar control groups, was not carried out.

7. The instructions were developed by the present investigator, as those used by Postman and Page were not available.

shown on the screen and read aloud by the experimenter:

"We want to see how well you can compare the sizes of rectangles. We will show you a rectangle approximately 6 1/2 inches wide and 4 3/4 inches high. This is the Standard and is marked with a large S.

"You are to compare each of the other rectangles with the standard, in terms of width only. By width we mean the left-right dimension, not the up-down dimension.

"You are to decide whether each rectangle is wider or narrower than the standard. To assist you in making your judgments, the standard will be shown frequently.

"When you see a rectangle, decide whether it is wider or narrower than the standard, and place a check mark (✓) in the corresponding column on the answer sheet. If you are not sure which answer is correct, make the best guess you can. Mark an answer for every rectangle except the ones marked with a large S.

"You will see each rectangle for a couple of seconds, and you will have a short time to mark your answer. Work quickly enough so that you do not miss any rectangles.

"Remember you are to judge only the width of the rectangle. Do not worry about the height or overall size.

"Do not change your judgment once you have decided. Do not compare results with anyone else. You will have a chance to ask questions before the experiment begins.

"If during the experiment,your pencil breaks or your light burns very dim or stops working, call out 'Stop!' in a clear voice so that the experiment may be interrupted and your equipment replaced."

Any questions were then taken up by the experimenter. When these were finished, the automatic shutter was turned on and the series exposed. At the completion of this first part (designated as Part I), there was a two-minute interval during which the film-

strip was rewound, and the answer sheets for the second part were distributed.

The instructions for the second part were as follows:

"This time we want you to compare each of the rectangles with the standard in terms of height only. By this we mean the up-down dimension.

"You are to decide whether each rectangle is taller or shorter than the standard. If you are not sure, guess. Mark your answers in the appropriate column on the answer sheet.

"The rest of the experiment will be the same, as before, only this time you are to judge only the height of the rectangle. Do not worry about the width or overall size."

The same stimulus sequence was followed in this second part. Another two-minute rest period followed, during which the filmstrip was rewound and answer sheets for the third part distributed.

The instructions for the third part were then presented:

"This time the procedure will be similar to the preceding. You are to compare the rectangles with the standard in terms of width only. By this we mean the left-right dimension.

"You are to decide whether each rectangle is wider or narrower than the standard. If you are not sure, guess. Mark your answer in the appropriate column of the answer sheet."

At the conclusion of the experiment the subjects were requested not to discuss the experiment with anyone who had not already participated, and their spontaneous observations were encouraged.

Scoring of the Rectangles Test

The responses of the 49 subjects were tabulated on a scoring sheet. One subject, a low anxiety Sharpener, was eliminated because his record was extremely deviant; he obtained a score of only 46 correct on the first part in contrast to the others in his group who scored 73 or above. For the remaining 48 subjects, scores were available for each of the thirteen rectangles shown seven times each in both parts of the test (pre- and post-interference). It was assumed that an approximate normal probability of response function would be obtained for each subject, and that at least two types of measures could be derived: the constant error, and a measure of precision of judgment derived from steepness of the slope of the function. These measures would be calculated separately for both parts of the Rectangles Test.

Rectangles Test
Order of Presentation of Rectangles

Order	Rectangle No.	Order	Rectangle No.	Order	Rectangle No.
1.	St	38.	13	75.	5
2.	6	39.	7	76.	8
3.	10	40.	10	77.	2
4.	3	41.	4	78.	12
5.	5	42.	9	79.	St
6.	1	43.	St	80.	6
7.	St	44.	5	81.	2
8.	11	45.	3	82.	3
9.	12	46.	6	83.	11
10.	7	47.	1	84.	1
11.	4	48.	7	85.	St
12.	2	49.	St	86.	10
13.	St	50.	9	87.	4
14.	13	51.	12	88.	5
15.	9	52.	13	89.	8
16.	8	53.	8	90.	12
17.	12	54.	10	91.	St
18.	4	55.	St	92.	9
19.	St	56.	6	93.	7
20.	5	57.	5	94.	13
21.	6	58.	3	95.	1
22.	2	59.	2	96.	9
23.	13	60.	4	97.	St
24.	3	61.	St	98.	8
25.	St	62.	1	99.	13
26.	8	63.	11	100.	10
27.	7	64.	4	101.	4
28.	10	65.	11	102.	12
29.	1	66.	1	103.	St
30.	9	67.	St	104.	7
31.	St	68.	10	105.	5
32.	11	69.	3	106.	6
33.	11	70.	7	107.	11
34.	2	71.	6	108.	3
35.	8	72.	9	109.	St
36.	12	73.	St	110.	2
37.	St	74.	13		

ANSWER SHEET - JUDGMENT OF RECTANGLES

Name _____ Sex _____ Age ____

Box number or street address _____ Date _____

Instructions: Place a check mark (✓) in the column which represents your judgment or best guess. Make a mark for every rectangle except the standard, which has a large "S" on it.

	Wider	Narrower
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
	Wider	Narrower
11.		
12.		
13.		
14.		
15.		
16.		
17.		
18.		
19.		
20.		
	Wider	Narrower
21.		
22.		
23.		
24.		
25.		
26.		
27.		
28.		
29.		
30.		
31.		
32.		
33.		
34.		
35.		
36.		
37.		
38.		
39.		
40.		
	Wider	Narrower
41.		
42.		
43.		
44.		
45.		

	Wider	Narrower		Wider	Narrower		Wider	Narrower
46.			66.			86.		
47.			67.			87.		
48.			68.			88.		
49.			69.			89.		
50.			70.			90.		
	Wider	Narrower		Wider	Narrower		Wider	Narrower
51.			71.			91.		
52.			72.					
53.			73.					
54.			74.					
55.			75.					
56.			76.					
57.			77.					
58.			78.					
59.			79.					
60.			80.					
	Wider	Narrower		Wider	Narrower			
61.			81.					
62.			82.					
63.			83.					
64.			84.					
65.			85.					

ANSWER SHEET - JUDGMENT OF RECTANGLES

Name _____

Instructions: Place a check mark (✓) in the column which represents your judgment or best guess. Make a mark for every rectangle except the standard, which has a large "S" on it.

	Taller	Shorter
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

	Taller	Shorter
11.		
12.		
13.		
14.		
15.		
16.		
17.		
18.		
19.		
20.		

	Taller	Shorter
21.		
22.		
23.		
24.		
25.		
26.		
27.		
28.		
29.		
30.		

	Taller	Shorter
31.		
32.		
33.		
34.		
35.		
36.		
37.		
38.		
39.		
40.		

	Taller	Shorter
41.		
42.		
43.		
44.		
45.		

Taller	Shorter	Taller	Shorter	Taller	Shorter
46.		66.		86.	
47.		67.		87.	
48.		68.		88.	
49.		69.		89.	
50.		70.		90.	
Taller	**Shorter**	**Taller**	**Shorter**	**Taller**	**Shorter**
51.		71.		91.	
52.		72.			
53.		73.			
54.		74.			
55.		75.			
56.		76.			
57.		77.			
58.		78.			
59.		79.			
60.		80.			
Taller	**Shorter**	**Taller**	**Shorter**		
61.		81.			
62.		82.			
63.		83.			
64.		84.			
65.		85.			

Scoring Sheet – Judgment of Rectangles

For Width score Wash, for Height score Tor S

Dimension (W or H) ___ S #

Session (1, 2, or 3) ___

Group ___

Rectangles / Subjects	W −6	−5	H −4	−3	W/H −2	W −1	St 0	H +1	W +2	W/H +3	+4	+5	+6	# Corr	# Wrong	
1																
2																
3																
4																
5																
6																
7																
# Corr																
# Wrong																
% Wrong																

Appendix V

RAW SCORES

Note: The four experimental groups are designated as in the text, as follows:

I	High anxiety Levelers
II	Low anxiety Levelers
III	High anxiety Sharpeners
IV	Low anxiety Sharpeners

Table XX

Scores on the Taylor Manifest Anxiety Scale (MAS)

I	II	III	IV
26	4	25	3
21	8	26	5
22	5	24	7
30	5	29	8
22	6	27	6
21	5	35	6
30	2	22	4
23	5	23	8
22	8	22	3
31	6	29	8
24		30	
23		27	
32		23	
33		24	

Table XXI

Scores on the Schematizing Test

Accuracy				Lack of Accuracy				Leveling-Sharpening			
I	II	III	IV	I	II	III	IV	I	II	III	IV
81	82	119	138	54	38	11	7	-0.21	0.96	4.16	5.23
72	70	126	136	58	50	19	4	-0.89	-0.64	3.88	5.36
58	97	122	132	57	43	18	18	-1.63	0.98	3.78	4.20
100	60	128	114	45	40	12	11	1.26	-0.33	4.46	3.95
66	65	130	126	31	40	15	19	0.54	-0.14	4.34	4.24
96	92	108	126	44	43	2	4	1.40	1.04	4.34	4.95
66	57	144	114	59	53	1	16	-1.44	-1.21	6.30	3.60
46	56	144	134	44	39	6	1	-1.21	-0.26	5.95	5.49
67	44	128	122	38	34	12	18	0.09	-0.58	4.83	4.13
95	84	126	138	40	36	24	12	1.10	1.19	3.53	4.88
63		118		62		17		-1.79		4.02	
93		134		42		11		1.16		4.78	
70		104		50		11		-0.64		3.54	
60		122		35		13		0.01		4.14	

Table XXII

Point of Subjective Equality (PSE) Scores[a]

I		II		III		IV	
Pre	Post	Pre	Post	Pre	Post	Pre	Post
-4	6	5	7	-5	-7	-5	-11
-24	-30	-5	-3	-3	-3	-7	- 9
-20	-15	-17	-7	-4	1	-4	- 6
-16	-17	- 7	-5	-4	-6	-6	- 6
-11	-20	-20	-10	-5	-12	-5	0
-16	-15	- 7	-13	3	-13	4	- 5
-14	5	-18	-25	-10	- 7	-7	-13
0	5	10	8	-10	- 2	-16	-24
-11	- 1	- 6	-24	- 2	7	- 3	- 2
- 8	-13	-13	-22	-6	3	- 8	- 7
- 3	2			-12	-11		
- 9	- 3			- 9	7		
4	- 7			- 5	-10		
-13	-16			-14	-10		

[a]These scores are actually the Sum fx' value, before dividing by N. To obtain the PSE in terms of the interval as the unit, divide these scores by 7, and add to 0.5. To obtain PSE in inches, multiply this last figure by 3/16. For purposes of analysis, all scores were changed to minus by adding -20, and the minus sign was dropped.

Table XXIII

Standard Deviation (SD) Scores[a]

I		II		III		IV	
Pre	Post	Pre	Post	Pre	Post	Pre	Post
389	330	314	259	318	230	236	217
434	442	290	300	254	203	210	203
614	517	275	146	151	181	245	131
251	340	398	280	185	200	214	160
344	400	334	177	280	251	254	141
342	280	275	344	223	295	160	230
363	265	325	387	227	265	210	280
312	300	370	214	278	151	267	382
361	248	193	407	220	210	136	131
346	372	230	362	207	242	214	203
165	273			325	230		
217	181			217	146		
378	165			305	251		
314	288			283	220		

[a]These scores have been carried out to two places beyond the decimal. The decimal has been omitted for computational convenience. To obtain the SD in inches, multiply by 3/16.

Table XXIV

Log Standard Deviation Scores[a]

I		II		III		IV	
Pre	Post	Pre	Post	Pre	Post	Pre	Post
159	152	150	141	150	136	137	134
164	165	146	148	140	131	132	131
179	171	144	116	118	126	139	112
140	153	160	145	127	130	133	120
154	160	152	125	145	140	140	115
153	145	144	154	135	147	120	136
156	142	151	159	136	142	132	145
149	148	157	133	144	118	143	158
156	139	129	161	134	132	113	112
154	157	136	156	132	138	133	131
122	144			151	136		
134	126			134	116		
158	122			148	140		
150	146			145	134		

[a]These scores represent 100 (log 10x), where x is the original raw SD score. Log 10x was used to avoid negative characteristics, and the decimal was dropped for computational convenience.

Table XXV

"Number Correct" Scores[a]

I		II		III		IV	
Pre	Post	Pre	Post	Pre	Post	Pre	Post
63	67	66	74	68	71	76	79
62	59	71	75	71	75	73	74
51	57	74	80	81	80	76	82
75	71	65	72	80	77	79	80
67	65	70	79	71	74	75	78
71	73	71	67	68	73	75	75
69	69	69	66	75	71	75	74
66	67	60	72	72	77	75	67
65	69	78	67	75	72	79	79
67	66	76	69	72	71	77	76
76	70			69	77		
76	74			75	75		
68	80			69	75		
72	75			73	79		

[a]Maximum score equals 84.

Table XXVI

Transformed "Number Correct" Scores[a]

I		II		III		IV	
Pre	Post	Pre	Post	Pre	Post	Pre	Post
209	221	218	244	224	233	251	265
207	199	233	248	233	248	240	244
178	197	244	270	276	270	251	283
248	233	215	237	270	256	265	270
221	215	230	265	233	244	248	260
233	240	233	221	224	240	248	248
227	227	227	218	248	233	248	244
218	221	201	237	237	256	248	221
215	227	260	221	248	237	265	265
221	218	251	227	237	233	256	251
251	230			227	256		
251	244			248	248		
224	270			227	248		
237	248			240	265		

[a]See text for derivation of these transformed scores. In this table, the scores are carried out to two decimal places, but the decimal has been omitted for convenience.

Table XXVII

Individual Scores of Extent of Change from Pre-Interpolation to Post-Interpolation Series

I			II			III			IV		
PSE	SD	"Number Correct"	PSE	SD	"Number Correct"	PSE	SD	"Number Correct"	PSE	SD	"Number Correct"
10	59	4	-2	55	8	-2	88	3	-6	19	3
-6	-8	-3	2	-10	4	0	51	4	-2	7	1
5	97	6	10	129	6	5	-30	-1	-2	114	6
-1	-89	-4	2	118	7	-2	-15	-3	0	54	1
-9	-56	-2	10	157	9	-7	29	3	5	113	3
1	62	2	-6	-69	-4	-16	-72	5	-9	-70	0
19	98	0	-7	-62	-3	3	-38	-4	-6	-70	-1
5	12	1	2	156	12	8	127	5	-8	-115	-8
10	113	4	-18	-214	-11	9	10	-3	1	5	0
-5	-26	-1	-9	-132	-7	9	-35	1	1	11	-1
5	-108	-6				1	95	8			
6	36	-2				16	71	0			
-11	213	12				-5	54	6			
-3	26	3				4	63	6			

Table XXVIII

Error Scores for Difficult and Easy Parts of the Rectangles Test

I		II		III		IV	
Pre	Post	Pre	Post	Pre	Post	Pre	Post
			Difficult				
12	10	10	4	11	12	2	1
7	6	4	1	10	8	10	10
6	7	6	4	2	1	2	1
5	4	6	7	0	4	2	2
11	9	6	4	9	6	5	5
8	8	9	10	7	5	7	5
8	11	8	7	8	10	8	5
12	11	11	8	7	7	4	5
13	13	4	6	6	7	5	5
11	12	5	7	12	10	4	6
8	10			9	3		
7	10			7	7		
6	2			6	4		
6	3			7	2		
			Easy				
9	7	8	6	5	1	6	4
15	19	9	8	3	1	1	0
27	20	4	0	1	3	6	1
4	9	13	5	4	3	3	2
6	10	8	1	4	4	4	1
5	3	4	7	9	6	2	4
7	4	7	11	1	3	1	5
6	6	13	4	5	0	5	12
6	2	2	11	3	5	0	0
6	6	3	8	0	3	3	2
0	4			6	4		
1	0			2	2		
10	2			9	5		
6	6			4	3		

Table XXIX

Retroaction Scores[a]

I	II	III	IV
1	0	1	-1
1	1	2	-1
1	1	0	2
1	-3	1	0
0	1	-3	1
0	-2	-3	-1
-3	1	-3	-3
-4	-1	-2	-1
-3	0	-2	-2
-2	-1	1	-3
-2		1	
-1		1	
0		-1	
3		4	

[a]Number correct, first 2 trials of post-interpolation series minus number correct, last 2 trials of pre-interpolation series.

Table XXX

Learning Scores[a]

I	II	III	IV
0	1	2	3
-2	5	0	3
-2	1	1	1
0	4	-2	3
3	2	4	1
1	0	9	1
4	1	1	5
2	3	2	1
4	0	3	3
2	-1	-1	3
3		5	
1		0	
4		1	
-2		0	

[a]Difference in number correct between first 2 and last 2 trials of the pre-interpolation series.

Table XXXI

Intertrial Variability[a]

I	II	III	IV
100	95	57	115
115	148	48	62
290	95	28	115
57	290	28	123
95	33	182	57
48	115	757	23
115	48	23	123
95	224	123	90
90	115	123	57
62	82	23	73
48		315	
15		23	
223		115	
157		62	

[a]These variance scores were carried out to two places beyond the decimal. The decimal has been omitted here for convenience.

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REFERENCES

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